THE
AMERICAN JOURNAL OF MEDICAL TECHNOLOGY

EDITOR-IN-CHIEF
ROSE MATTHAEI
M.T. (ASCP)
2119 Arbor Ave.
Houston 4, Texas

EDITORIAL STAFF
ADVISORY EDITORS
A. H. BRADEN, M.D.
1704 Crawford St.
Houston 3, Texas

MRS. DORIS WHITNEY
M.T. (ASCP)
65 West Chicago St.,
Roselle, Illinois

ASSOCIATE EDITORS
MARY F. EICHMAN
M.T. (ASCP)
440 Lyceum Ave.
Philadelphia 28, Penna.

LUCILE HARRIS
M.T. (ASCP)
Hendrick
Memorial Hospital
Abilene, Texas

HELEN MADDEN
M.T. (ASCP)
86 Jersey St.
Boston, Mass.

MARY NIX
M.T. (ASCP)
4931 N.E. Glisan
Portland, Oregon

ESTHER LEMONT
M.T. (ASCP)
3950 North Farwell Ave.
Milwaukee 2, Wisconsin

The publishers accept no responsibility for opinions expressed by contributors.

CONTENTS

VOLUME SEVENTEEN NUMBER 6
NOVEMBER-DECEMBER
1951

Page

TWO CLINICAL PROCEDURES OF INTEREST TO THE MEDICAL TECHNOLOGIST: with Adaptation to the Coleman Spectrophotometer

THE DETERMINATION OF LIPID PHOSPHORUS 265

THE POWELL METHOD FOR THE DETERMINATION OF SERUM BILIRUBIN 267
Elizabeth Maclay, MT (ASCP)

THE TECHNOLOGY OF BLOOD 271
Charles A. Janeway, M.D.

USES AND ABUSES OF THE FLAME PHOTOMETER 276
Anne J. Sommer, MT (ASCP)

LABORATORY PLANNING 283
Sister Mary of Mercy, J. O. M.

LIFE SPAN OF Rh$_o$ ANTI-BODIES 286
Lester J. Unger, M.D.

A MICRO TECHNIQUE FOR PROTHROMBIN TIMES 290
Jeannette Sanduzzi, MT (ASCP)

VIRAL HEPATITIS: AN OCCUPATIONAL HAZARD TO MEDICAL TECHNOLOGISTS 293
Sydney S. Gellis, M.D.

THE IMPORTANCE OF THE TRAINED LABORATORY ANIMAL ATTENDANT ... 298
C. N. W. Cumming and F. G. Carnochan

THE ISOLATION OF PATHOGENS IN SUSPECTED FOOD POISONING 302
Adabelle Noyes

ABSTRACT 305

AMONG THE NEW BOOKS 306

THE GAVEL 308

ANNOUNCEMENTS 308

INDEX 312

The American Journal of Medical Technology is owned by the American Society of Medical Technologists. It is published bi-monthly, the volumes beginning with the January issue.

American Society of Medical Technologists

OFFICERS

President—Lavina White, Pueblo Clinic, Pueblo, Colorado.
President-elect—Sadie Cartwright, 605 East 51st Street, Savannah, Georgia.
Recording Secretary—Sister Charles Miriam (Strassell), St. Joseph's Hospital, Albuquerque, New Mexico.
Treasurer—Mary F. Eichman, 440 Lyceum Avenue, Philadelphia 28, Pennsylvania.

EXECUTIVE SECRETARY

Rose Matthaei, Suite 25, Hermann Professional Bldg., Houston 25, Texas.

ADVISORY COUNCIL

BOARD OF DIRECTORS

Lavina White, Chairman, Pueblo, Colorado.
Sadie Cartwright, Savannah, Georgia.
Sister Charles Miriam (Strassell), Albuquerque, New Mexico.
Mary F. Eichman, Philadelphia, Pennsylvania.
Barbara Isbell, 4781 Santa Cruz, San Diego 7, California.
Mrs. Elinor Judd, Robert B. Brigham Hospital, Boston, Massachusetts.
Lucile Harris, Hendrick Memorial Hospital, Abilene, Texas.
Mary Frances James, Medical College of Alabama, Birmingham, Alabama.
Anne J. Sommer, 3803 Utah Place, St. Louis 16, Missouri.
Grace Ballard, 925 North 13th Street, Milwaukee, Wisconsin.
Mrs. Vernal J. Schene, 523½ East Warner, Guthrie, Oklahoma.

PRESIDENTS OF STATE SOCIETIES

Sarah Eidson, 13 East South St., Montgomery, Alabama.
Mrs. Bennie Bargas, 621 Harvey Road, Memphis, Tennessee (Arkansas).
Adabelle Noyes, 338 Willow Ave., Corte Madera, California.
Rose M. Hackman, 4200 East 9th Avenue, Denver, Colorado.
Lydia Brownhill, Meriden Hospital, Meriden, Connecticut.
Sarah N. Bruce, Memorial Hospital, Wilmington 12, Delaware.
Mrs. Martha F. Spiegel, 4201 Massachusetts Avenue Northwest, Washington 7, D. C.
Anna Bell Ham, 1190 Alhambra Circle, Coral Gables, Florida.
Carolyn Martin, 1201 Clifton Road N. E., Atlanta, Georgia.
Jessie Meador, 314-A Seaside Avenue, Honolulu, T. H.
Ralph Miller, 704 Fern Street, Nampa, Idaho.
Mrs. Lois Fehrmann, 429 South Liberty St., Elgin, Illinois.
Martha J. Brockmole, 700 Mary Street, Evansville, Indiana.
Lorraine Lawrence, Broadlawns Hospital, Des Moines, Iowa.
Ruby Downum, 408 South Water, Wichita 2, Kansas.
Sister Mary Simeonette (Savage), 851 South 4th St., Louisville 3, Kentucky.
Norma M. Bender, Baton Rouge General Hospital, Baton Rouge, Louisiana.
Mildred Trefs, 1205 St. Paul St., Baltimore 2, Maryland.
Dorothy B. Prest, Salem Hospital, Salem, Massachusetts.
Mrs. Betty Stearns, 5645 North Okemos Road, East Lansing, Michigan.
Ruth Hovde, 515 Southeast Delaware, Apt. 104, Minneapolis 14, Minnesota.
Margaret Jackson, Physicians & Surgeons Laboratory, Greenwood, Mississippi.
Anne J. Sommer, 3803 Utah Place, St. Louis, Missouri.
Berenice Bayliss, 616 South Grand, Bozeman, Montana.
Doris Dovel, 2123 South 17th, Lincoln, Nebraska.
Chrystal Clinesmith, 525 West St., Reno, Nevada.
Sister Mary of Mercy (Frost), Sacred Heart Hospital, Manchester, New Hampshire.
Samuel Feder, Newcomb Chest Hospital, New Lisbon, New Jersey.
Vivian Dunton, Box 83, Taos, New Mexico.
Mildred R. Talluto, 1431 North Goodman St., Rochester, New York.
Anna Mary Peirce, 419 Church Street, Greensboro, North Carolina.
C. Patton Steele, Public Health Laborntory, Box 1020, Bismarck, North Dakota.
Sarah Hanna, 1439 East Third Street, Salem, Ohio.
Bessie Mae Mills, 228 N. W. 13th Street, Oklahoma City 3, Oklahoma.
Marjorie Robertson, 3405 S.W. 10th Avenue, Portland 1, Oregon.
Dorothy Pfender, 5936 North 5th Street, Philadelphia, Pennsylvania.
Florence C. Moran, Memorial Hospital, Pawtucket, Rhode Island.
Alice E. Cole, McLeod Infirmary, Florence, South Carolina.
Mrs. Audrey Phillips, 613 South 4th Avenue, Apt. 3, Sioux Falls, South Dakota.
Sara Grace Richmond, 1576 Carr Avenue, Memphis 4, Tennessee.
Elsie Urbantke, 1700 Palma Plaza, Austin 21, Texas.
Mrs. Ruth Ball Orlob, 1212 - 32nd St., Ogden, Utah.
Mary E. Breen, 17 Whitney Street, Winooski, Vermont.
Mrs. Frances H. Crouch, 3633 Roundhill Ave., Roanoke 12, Virginia.
Ruth Church, Children's Orthopedic Hospital, Seattle, Washington.
Gordon S. Starkey, The Myers Clinic, Philippi, West Virginia.
Elaine Beck, 3321 North Maryland, Milwaukee 11, Wisconsin.
Mrs. June G. Fautin, 1002 Park Place, Laramie, Wyoming.

AMERICAN JOURNAL OF MEDICAL TECHNOLOGY

Rose Matthaei, Suite 25, Hermann Professional Bldg., Houston 25, Texas

The
AMERICAN JOURNAL
of
MEDICAL TECHNOLOGY

VOLUME 17 NOVEMBER-DECEMBER, 1951 NUMBER 6

TWO CLINICAL PROCEDURES OF INTEREST TO THE MEDICAL TECHNOLOGISTS*

with adaptation to the Coleman Spectrophotometer

By ELIZABETH MACLAY, B.A. M.T. (ASCP)
Mayo Clinic Laboratories, Rochester, Minn.

THE DETERMINATION OF LIPID PHOSPHORUS

Those who have attempted the determination of lipid phosphorus (lecithin) in plasma or tissue by any of the commonly used methods have encountered a number of troublesome problems. Among these problems are high color in the blank, too much or too little color in the sample being assayed or the fading of color.

Since lipid phosphorus has clinical significance in certain pathological conditions, a reliable procedure for its determination would be a definite asset to the medical technologist and to the clinician. A survey of the literature revealed several possible methods.

In 1942 Gomori[1] published a modification of the Kuttner and Lichtenstein[2,3] method for the determination of inorganic phosphorus. In principle it was similar to the Kuttner and Lichtenstein method; but instead of using stannous chloride as the reducing agent with sodium molybdate-sulfuric acid reagent it substituted a solution of p-methylamine phenol sulfate (Elon).

Whereas the stannous chloride-molybdate reaction gave reproducible results within a very narrow range of acidity, the Elon-molybdate reaction was found to be satisfactory at a much wider range. According to the author the elon tolerance to acid is 0.9 to 2.2 ml. of concentrated acid. In other words the use of elon with 5 ml. of molybdate-sulfuric acid reagent will tolerate an additional 0.5 ml. of concentrated H_2SO_4 without upsetting the degree of color development.

* Hillkowitz Award Paper, Read before ASMT Convention, Swampscott, Mass., June 1951

This wider range of tolerance to acid was found to be a distinct advantage in adapting the Gomori method to the determination of lipid phosphorus. By combining the Youngburg[4] ashing process, with the color development of Gomori a procedure was evolved which could be adapted to use with the Coleman spectrophotometer. The combined methods offered a workable and reliable procedure. The results obtained were readily reproducible.

THE METHOD

Place 35 ml. of ether-alcohol solution in a 50 ml. volumetric flask. Add, with shaking, 3 ml. of plasma. Heat the flask over boiling water until the contents come to a boil. Cool and make to the mark with ether-alcohol. Filter through fat-free filter paper (Whatman #43).

Measure 5 ml. of the filtrate into a pyrex tube (19x200 mm.) containing 2 or 3 beads. Heat over boiling water until the ether and alcohol have evaporated. Add 0.5 ml. of 10N H_2SO_4 and heat in a cone type electric heater (or other source of steady heat) until the contents of the tube have charred and a ring of acid has risen 1 or 2 inches up the walls of the tube. Cool the tube and add 2 or 3 drops of phosphate-free 30 per cent hydrogen peroxide (Superoxol). Reheat until the acid ring has again risen in the tube. The acid mixture should be clear and free of carbon flecks. More peroxide may be added if needed. Remove the tube from the heater and pass it several times through a flame, heating from the acid level toward the mouth of the tube, to drive off the excess peroxide. Cool the tube and add 3 ml. of distilled water and heat to boiling for 10 seconds. Cool and make to a volume of 6 ml. with distilled water.

Place 2 ml. of the solution in a Coleman cuvette (19x105) and add 5 ml. of acid-molybdate reagent and 0.25 ml. of elon. Mix well and allow to stand for 1 hour. Read in the Coleman spectrophotometer at a wave length of 700 mu, against a reference tube containing 2 ml. water, 5 ml. acid-molybdate and 0.25 ml. of elon. The values in mg. per 100 ml. of plasma are read from a standard chart. This chart is prepared from a graph which represents the readings of standard phosphate solutions plotted on semilogarithmic paper against the mg. per 100 ml of standard. The several points on the graph are arrived at in the following manner. A stock standard containing 4.394 grams of KH_2PO_4 in 1 liter of water is prepared. One ml. of this solution contains 1.0 mg. of phosphorus. From it dilute standards are prepared containing respectively 2, 4, 6, 8, 10 and 12 mg. of phosphorus per 100 ml. of solution. Measure 2 ml. from each of these dilute standards into Coleman spectrophotometer cuvettes (19x105) and add to

each 5 ml. of acid-molybdate reagent for standards and 0.25 of elon. Mix the contents of each cuvette thoroughly and allow to stand for 1 hour for full color development. The readings in the Coleman spectrophotometer are made using a cuvette containing 2 ml. of water, 5 ml. of acid-molybdate solution and 0.25 ml. of elon, as reference. The several readings, when plotted on semi-logarithmic paper should fall on a straight line. The values in milligrams of lipid phosphorus (lecithin) per 100 ml. of plasma are calculated from the graph and are charted opposite the corresponding spectrophotometer readings.

REAGENTS

1. **Ether-alcohol.** 1 part of redistilled anesthetic ether and 3 parts of redistilled 95 percent alcohol (ethanol).
2. **10N H_2SO_4.** Add 450 ml. of concentrated H_2SO_4 to 1200 ml. of water and standardize.
3. **30 per cent Hydrogen peroxide (Superoxol).** Pure, phosphate-free.
4. **p-Methylamine phenol sulfate** (Elon; Eastman Kodak Co.). 3 gms. sodium sulfite, 1 gm. elon and make up to 100 ml. with water.
5. **Sulfuric acid-sodium molybdate A.** (for standards 7.25 gm. sodium molybdate and 72.5 ml. 10N H_2SO_4 made to 1 liter with water.
6. **Sulfuric acid-sodium molybdate B.** (for samples) 7.25 gm. sodium molybdate and 55.8 ml. of 10N H_2SO_4 made to 1 liter with water.
7. **Standard phosphate (stock).** 4.394 gm. KH_2PO_4 to 1 liter with water.

ACKNOWLEDGEMENT

I am indebted to Dr. H. M. Power of the Section of Biochemistry of the Mayo Clinic for suggesting the adaptation of the Gomori inorganic phosphorus method for the determination of lipid phosphorus.

BIBLIOGRAPHY

1. Gomori. J. Lab. & Clin. Med. 27, 955. 1942.
2. Kuttner and Cohen. J. Biol. Chem. 75, 517. 1927.
3. Kuttner and Lichtenstein. J. Biol. Chem. 86, 671. 1930.
4. Youngburg and Youngburg. J. Lab. & Clin. Med. 16, 158. 1930.
5. Hawk and Bergeim "Practical Physiological Chemistry." 11th edition, 449.

THE POWELL METHOD FOR THE DETERMINATION OF SERUM BILIRUBIN.

In 1944 Powell[1] described a method for the determination of serum bilirubin that is "simple, rapid and accurate" and lends itself readily to clinical use. Sodium benzoate and urea solution were used to make possible the determination of "total" and "di-

rect" bilirubin entirely within aqueous solutions. By subtracting the value for direct bilirubin from that for total the indirect value was obtained.

Powell described his method for use with the Klett-Summerson photoelectric colorimeter. It was desirable for our purpose that it be adapted to use with the Coleman spectrophotometer, and therefore it was necessary to plot a curve of concentration versus transmittance for various quantities of bilirubin. Accordingly, a solution of bilirubin in chloroform was prepared so that 1 ml. of solution contained 0.05 mg. of bilirubin. A series of five tubes containing, respectively, 1,2,3,4,5 ml. of the chloroform solution was prepared. To each tube was added sufficient 95 per cent alcohol to make the volume 47.5 ml. Then to each tube was added 2.5 ml. of freshly prepared diazo reagent. The contents of each tube were well mixed and allowed to stand thirty minutes for full color development. A spectrophotometric reading was made against an alcohol blank. The readings in terms of per cent of transmittance were then plotted on a logarithmic scale against the values in milligrams per cent along a linear scale.

Unfortunately, recovery of bilirubin added to serum and determined according to the Powell procedure for total bilirubin, was poor when the spectrophotometric readings were evaluated by the chart just described. It appeared that bilirubin and diazotized sulfanilic acid did not yield as much color in sodium benzoate and urea as in alcohol. Therefore, it seemed advisable to determine the relation between the amount of bilirubin and the spectrophotometric reading under the conditions of Powell's method. The plan ultimately arrived at for accomplishing this purpose was as follows: To each of five tubes (75 ml. capacity) was added, respectively, 1, 2, 3, 4, and 5 ml. of the bilirubin solution in chloroform. Each tube was treated in turn, and each test was completed before the next was begun. Tube 1 was heated in a water bath until the chloroform had evaporated, leaving the dry bilirubin in the bottom of the tube. While the tube was still hot, three drops of a 1.0 per cent solution of sodium carbonate were added to the residue in the tube. By rotating the tube so that the carbonate was brought into contact with every particle of bilirubin, complete solution was effected. The contents of the tube were then transferred quantitatively with repeated small portions of sodium benzoate-urea solution to a tube containing 1 ml. of serum*. Another drop of carbonate was added and the process was repeated until no trace of bilirubin remained. The mixture of serum and the solution of bilirubin was made to exactly 47.5 ml. with the solution of benzoate and urea; 2.5 ml. of

*The presence of serum in the reaction mixture was found to be essential to proper color development. When no serum was present the diazo reaction gave a blue color instead of a red one.

freshly prepared diazo reagent were added and the contents of the tube mixed thoroughly. A reading was made in the Coleman spectrophotometer within five minutes. The blank was 1 ml. of the serum, 3 or 4 drops of the 1.0 per cent carbonate solution, sufficient sodium benzoate-urea solution to make the volume 47.5 ml., and 2.5 ml. of solution A. The same process was repeated with each of the five tubes. The readings so obtained were plotted on semilogarithmic paper against the corresponding amounts of bilirubin in terms of milligrams per 100 ml. While a wave length of 550 mu was most suitable for alcohol-bilirubin spectrophotometer readings, it was found that maximum absorption of azobilirubin prepared in the presence of sodium benzoate and urea was at wave length 530 mu. The readings, therefore, were made at 530 mu. From the graph obtained a chart for direct reading of values of bilirubin in mg. per 100 ml. of serum was prepared. Bilirubin added to serum was recovered quantitatively when the chart just described was used.

SAMPLE OF RECOVERY

	Bilirubin in serum	Bilirubin added	Expected recovery	Actual recovery
I	0.5 mg%	0.2 mg. or 20 mg%	20.5 mg%	20.64 mg%
II	0.5 mg%	0.04 mg. or 4 mg%	4.5 mg%	4.48 mg%

The clinical test for serum bilirubin concentration according to the technic of Powell with adaptation to the Coleman spectrophotometer is as follows:

METHOD

Reagents.—1. Solution A. One gram of sulfanilic acid is dissolved in a little water containing 15 ml. of concentrated hydrochloric acid and the solution is diluted to a volume of 1 liter with distilled water.

2. **Solution B.** 0.5 per cent solution of sodium nitrite in distilled water.

3. **Diazo Reagent.** Prepare fresh reagent daily by adding 0.3 ml. of solution B to 10 ml. solution A.

4. **Diazo blank solution.** Use Solution A.

5. **Sodium benzoate-urea solution.** (S.B.U.) Ten grams of sodium benzoate are dissolved in about 60 ml. of water. Ten grams of urea are added and dissolved and the solution is diluted to 100 ml. with distilled water. This solution should be allowed to age for 10 days before using.

The Procedure. In each of four tubes (Coleman cuvettes 19 x 105) place 0.5 ml. of serum. To two of these tubes (1 and 3) add 0.5 ml. diazo reagent and to the others (2 and 4) add 0.5 ml. of so-

lution A. If there is **no** color change (pink or red) in the diazotized tubes in the first minute after mixing, the reaction is considered to be negative for direct bilirubin and is so recorded.

Direct bilirubin. In case a color change **is** observed in the first minute after diazotizing, 9 ml. of distilled water are added to each of tubes 1 and 2, the contents are mixed thoroughly and allowed to stand ten minutes for full color development. The transmittance of the color in tube 1 is then read in the spectrophotometer (wave length 530 mu) with tube 2 as reference blank. If the reading is high for the spectrophotometric scale dilute the reaction mixture with water **after** the color is fully developed.

Total bilirubin. To each of tubes 3 and 4 above, add 9 ml. of S.B.U. and within **five** minutes read the transmittance of the color in tube 3 with tube 4 as reference blank. S.B.U. causes prompt and complete development of color. The intensity of color may diminish slightly after five minutes. The bilirubin values are read from the chart for bilirubin concentration. Indirect bilirubin values are the difference between total and direct bilirubin. If total bilirubin values are too high to be read on the spectrophotometric scale dilute as needed with S.B.U.

ACKNOWLEDGEMENTS

I wish to express my gratitude to Dr. H. L. Mason and Dr. H. M. Power of the Section of Biochemistry, Mayo Clinic, for helpful suggestions and constructive criticism; and to Dr. Wozencraft, formerly on Fellowship at the Mayo Foundation, for determining the optimum wave length.

1. Powell, W. N. Am. J. Clin. Path. 14, 55. 1944.

THE TECHNOLOGY OF BLOOD*

By CHARLES A. JANEWAY, M.D.[1]

It is a great pleasure for a physician to appear before this impressive gathering and pay tribute to your group, who represent such a vigorous and rapidly growing branch of the professional family concerned with health in our country. As the fundamental sciences of chemistry and physics have provided the tools and concepts which have extended our knowledge of human biology and pathology, we have passed from the era of "the good old family doctor" with his horse and buggy, his black bag of pills and his own pet prescriptions to the day of the medical team with doctor and nurse working closely with the technologist in the application of scientific knowledge to the prevention, diagnosis, and treatment of disease.

The collection, processing, stockpiling, and distribution of blood and its derivatives has become our biggest and most important biologics operation in this country. Upon the success of this operation depend, to a considerable extent, the lives of our citizens in event of a national emergency, the lives of many a United Nations soldier fighting for the free world in Korea, and the lives of all of us in a country where accidents take a greater toll of civilian life than wars and, at the same time, such miracles have become commonplace as the surgical reconstruction of the heart and great vessels or the maintenance in a state of health for years, of a child with congenital absence of fibrinogen.

The therapeutic use of human blood has been completely dependent upon the technical application of fundamental biological and chemical knowledge. Transfusion was tried repeatedly with bad results until Landsteiner discovered the ABO groups. When this discovery was applied to transfusion the safe transfer of red blood cells from one donor to another recipient became possible. The next essential advance was sufficient understanding of the chemical reactions involved in blood coagulation to make it possible to keep blood in a fluid state outside of the body by combining the calcium ions with citrate. The technical development of these two basic scientific discoveries has made the modern blood bank possible. This has resulted in such an extraordinary simplification of the process of giving blood to the patient who needs it that the number of transfusions in this country has multiplied enormously.

[1] Thomas Morgan Rotch Professor of Pediatrics, Harvard Medical School; Physician-in-Chief, The Children's Hospital, Boston, Mass.; Chairman Committee on Blood and Blood Derivatives, Division of Medical Sciences, National Research Council; Member, Committee on Medical Policies and Procedures, National Blood Program, American Red Cross.

*Paper presented before the Nineteenth Annual Meeting of the American Society of Medical Technologists, June 26, 1951.

UNIVERSITY OF MICHIGAN LIBRARIES

The practical *tour de force* of collecting blood from approximately one in every thirty-five or forty civilians each year, of drawing blood in Seattle or Los Angeles and administering it on the battlefields of Korea, or of completely replacing the blood of an infant with erythroblastosis fetalis has tended to blind us to the deficiencies of our present technical methods of handling blood. Although adequate for the transfer of red cells and the stable plasma proteins from one individual to another under most conditions, these methods are not adequate, if rigorously examined in the light of our present needs.

The possibility of atomic attack on this country presents us with a colossal problem—the immediate need for unprecedented amounts of blood in a short time to treat the huge number of traumatic casualties and the subsequent need for white blood cells, platelets, and the proteins concerned with blood coagulation and immunity, as well as for red blood cells, to combat the later effects of ionizing radiation. To meet this problem, two things are required, methods for preserving and thus for stockpiling blood and its derivatives in huge quantities or at least methods for permitting the transfer of viable formed elements and labile proteins from donor to recipient. Careful study has revealed that present techniques for the transfusion of so-called "whole blood" actually are only methods for transferring viable red blood cells and certain of the more stable plasma proteins from one person to another. White blood cells, platelets, and such essential labile proteins as plasma Ac globulin and antihemophilic globulin are greatly reduced or absent in most bank bloods, and the process of chemical deterioration starts as soon as the blood enters the needle from the donor's vein. Thus, the major problem for investigation at the moment is the preservation of all the formed elements and proteins of blood, so that they may be stored for therapeutic use when needed and retain their vital physiological functions.

A second problem, connected with the widespread use of human blood, is the transmission of disease, particularly hepatitis, from one individual to another. We must not only learn how to preserve each component of the blood but also how to sterilize it, so that blood and its derivatives may be as well standardized, as consistently potent, and as safe as the reagents and drugs which we use constantly in our daily work.

How far has progress been made along these lines? One can hardly say that we've reached the millenium, but during the last few years, intensive investigations have begun to create a new blood technology, based on advancing knowledge of the biochemistry of the various cellular and protein constituents of blood. It is not yet possible to transfuse the patient with agranulocytosis with large numbers of preserved leukocytes, nor the

patient with thrombocytopenic purpura with large numbers of preserved platelets, but it is possible to separate each of these important blood components from the rest of the blood and to study their biological and chemical properties and the requirements for their preservation. Sterilization techniques adequate to destroy the virus of hepatitis without too great damage to the function of the blood proteins are only applicable to plasma and serum albumin at present. Two developments deserve particular mention because they seem most likely to affect the technical operations of blood banks in the near future—new equipment for whole blood transfusion and the use of blood derivatives.

Blood transfusion equipment. Early workers in the field of blood transfusion recognized that the surface of the vessel containing the blood had a marked influence on the rate at which clotting occurred, and early transfusion equipment used paraffined surfaces rather than chemicals to prevent clotting. This was forgotten after the development of sodium citrate as an anticoagulant because of the great convenience of glass bottles and rubber tubing, until Jaques demonstrated that silicone treatment of the glass container markedly prolonged the clotting time. An analysis of the factors involved in initiating the clotting mechanism reveals that the extent to which tissue is traumatized by the venipuncture, the eddying which occurs in the needle and tubing, and the surfaces which the blood must contact during its passage into the container are all important. Ordinary needles, rubber tubing, and glass container initiate the early chemical phases of clotting and alter the blood considerably. Accordingly, Dr. Carl Walter, working with a group of his colleagues, has developed a new type of blood transfusion equipment to counteract these various factors. Needles are specially ground to minimize trauma to tissues, with a constant internal bore to avoid eddies and to permit laminar flow, with all surfaces non-reactive —the steel electropolished and treated with a hemo-repellent compound, and the tubing and container made of transparent non-reactive polyvinyl plastic.

A large interface between air and the surface of the blood such as occurs in the ordinary blood bottle has been shown to diminish preservation. This type of plastic vessel contains no air and thus provides no such interface. From the standpoint of sterility and consequent safety of the blood, this equipment provides a closed system without any of the hazards attendant upon a vacuum bottle; no vacuum is necessary since, because of the flexible character of the plastic, the bag is distended by the blood as it is forced in by the pressure in the donor's occluded vein until it becomes filled to capacity. This flexibility is equally advantageous for storing and handling the blood. In storage and shipment breakage is less of a problem than with glass. In the separa-

UNIVERSITY OF MICHIGAN LIBRARIES

tion of plasma from red cells, very complete separation may be achieved after sedimenting or centrifuging the cells, because plasma can be squeezed out of the bag until the sharp plasma-cell interface reaches the outflow tube. The remaining cells are then available for further storage and administration without transfer from the original container. Finally, for administration of the blood, no air way is necessary, as atmospheric pressure collapses the bag. If gravity does not give a rapid enough flow, external pressure may be applied to the bag, without the necessity of forcing air into a rigid bottle and thus running the risks of contamination of the blood or of air embolism in the recipient. Beyond these advantages are those of logistics—small space and weight of such equipment in storage or transit, and the low requirements for critical materials. The main drawback is that, at room temperature, water vapor passes through such plastics, and thus plastic vessels containing ACD solution must be sealed in cans for storage. There are a few other drawbacks—the necessity for weighing the bags in order to determine that the proper amount of blood is drawn and the need for some supporting container because of the non-rigid character of the vessel. However, physicians and nurses who have once become familiar with the use of this type of equipment have become enthusiastic about its practical advantages quite apart from the fact that it was primarily designed to preserve the blood it was to contain. Nearly 1000 transfusions have been given in Boston hospitals with this type of equipment, and studies by Drs. Gibson and Sack and Emerson have demonstrated that red cells of blood drawn into ACD solution are preserved at least as well as in conventional types of equipment.

The Use of Blood Derivatives

It is now ten years since Professor Edwin J. Cohn of Harvard first introduced his methods for the large-scale fractionation of human plasma into its major physiological components. Medical progress has always depended on the purification, characterization, and physiologic and clinical study of the active principles of biologically important tissues, as, for example, in the case of ACTH and Cortisone at present. Dr. Cohn has made this possible with human blood. His work has not only given us therapeutic agents like serum albumin for the treatment of shock and hypoproteinemia and gamma globulin for the control of measles and infectious hepatitis, but has also made possible many important investigations on the relation between the chemical structure of the proteins of the blood and the vital physiological functions which they perform.

The concept of the use of blood derivatives—red blood cells, serum albumin, serum gamma globulin, and Fraction I contain-

ing fibrinogen antihemophilic globulin—for many clinical uses rather than blood or plasma is important for several reasons. First, it promotes *economy* in the use of blood, a single donation being used for the treatment of a number of patients instead of one, who may only need a single component of the blood transfused. Second, it permits better *preservation,* since each component can be stored under the conditions best suited to it. This extends the dating period and promotes economy still further. Third, it provides therapeutic agents of *greater potency,* in which the desired physiological function has been concentrated. Finally, it *diminishes the risks of transmitting hepatitis* where sterilization techniques can be applied. Serum albumin is so stable that it can be sterilized by heating to 60° C for 10 hours in the final container. Gamma globulin, although not stable enough to permit this type of sterilization, has been shown not to transmit the virus of hepatitis. Fraction I, on the other hand, has been found to transmit hepatitis, and its sterilization requires intensive study.

Better preservation of blood and hence economy in the use of this vital human resource will continue to depend, as it has in the past, on technical application of scientific knowledge. Knowledge about the seventy or more components—both formed elements and soluble proteins—which give the blood its unique functional properties is accumulating rapidly. The selection and protection of the blood donor, and the proper utilization of blood and its derivatives in the treatment of the sick and the protection of health are the function of the physician. *The protection of the blood, from the time it leaves the donor until it or its products are returned to the physician for clinical use, is the function of the technologist.* You may anticipate an increasingly important role in this greatest of all biologics operations, the national blood program, which, when all its parts are included—the activities of the Red Cross, the Department of Defense, the various Civil Defense Agencies, the independent blood banks, and the commercial laboratories—is processing nearly five million bloods annually at present.

USES AND ABUSES OF THE FLAME PHOTOMETER*

By ANNE J. SOMMER, B.S., M.T. (ASCP)
Firmin Desloge Hospital, St. Louis, Missouri

The use of the flame photometer as a precision instrument in the clinical laboratory is beginning to replace the more laborious and time-consuming methods for the determination of cations in blood, urine, and other body fluids. Unfortunately, the unwary medical technologist may adopt the mistaken belief that the flame photometer is the panacea for all the sodium and potassium troubles one experiences with the gravimetric and spectrophotometric methods. However, after several weeks of experimentation it becomes clear that flame photometry is surrounded with its own aura of mysteries which must be solved before accurate and reliable results will be attained.

This paper will not discuss the theoretical aspects of flame photometry but rather will enumerate briefly some of the practical difficulties encountered in setting up a flame photometer and adapting it to the general and local conditions which prevail. It is hoped that this paper may, in some small way, contribute to the solution of the difficulties encountered by others.

The instrument to which we will refer throughout this paper is the Weichselbaum-Varney[1,2] Flame Spectrophotometer. Figure 1 illustrates schematically the burner-atomizer system. Illuminating or natural gas is mixed uniformly with a pressure regulated stream of oxygen in the "mixing chamber." The gas-oxygen mixture then enters the burner-atomizer system through the "oxy-gas inlet." Oxygen, under a constant pressure of 7 to 10 pounds, enters the tube of the "aspirator" at the "oxygen inlet," and escapes at the narrow "concentric space" which lies between the "needle" and the aspirator tip. This arrangement produces a venturi effect which accomplishes the pickup and atomization of the specimen to be analyzed.

The flame produced by this burner atomizer system is the net result of the combustion of the oxygen-gas mixture with the high pressure oxygen from the aspirator. The portion of the flame directly attributable to the oxygen-gas mixture is shown as the "inner cones"; while the hottest portion, resulting from the combustion, is labeled "luminous column." Thermal excitation of the atomized specimen is accomplished within the "luminous column," and this light is collected by the lens system from the region labeled "high intensity." Both the burner and the exhaust stack of the instrument are water cooled.

* Read before ASMT Convention, Swampscott, Mass., June 1951

THE WEICHSELBAUM — VARNEY

UNIVERSAL SPECTROPHOTOMETER

BULLETIN NUMBER 151-A

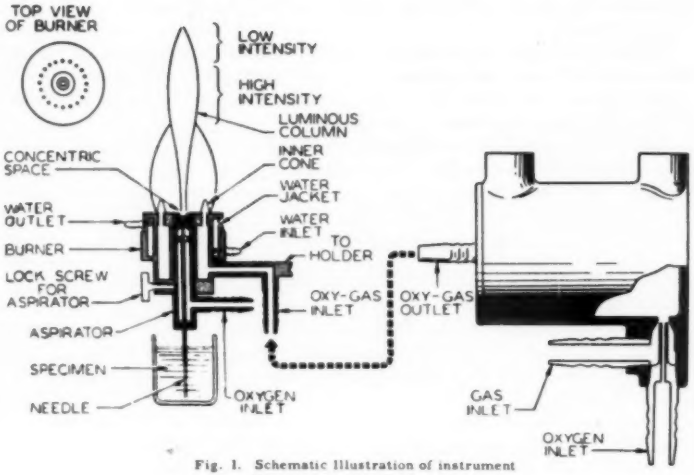

Fig. 1. Schematic Illustration of instrument Burner-Atomizer System

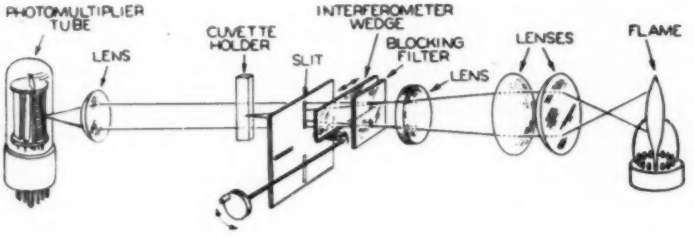

Fig. 2. Schematic Illustration of Instrument Optics System

Reprinted with the permission of T. E. Weichselbaum.

Figure 2 illustrates the light monochromating and optical systems. The light passes through a series of lenses, blocking filter, interferometer wedge, and slit. The monochromated light is then condensed by suitable lenses and impinges upon the light sensitive surface of the photomultiplier tube—to convert light energy into electrical energy. The intensity of the radiated light is measured either by means of a linear scale or optical density scale.

Theoretically it is possible to determine any cation which gives characteristic spectral lines when introduced into a gas flame; however, we are most interested in the sodium, potassium, and calcium determinations at present.

Weichselbaum[3,4] has recently pointed out the extreme accuracy attained with the W-V instrument. In recovery experiments we have been able to duplicate results within one to two per cent.

Problems and Their Solutions

The best way to approach the problems we have encountered is to recall them as they occurred.

1. Gas pressure—In the folder accompanying the W-V instrument it is suggested that a representative of the gas company be asked to check the gas pressure to assure a constant supply of gas. We happen to be situated in a low gas pressure area of the city (as are many other hospitals) and instead of a pressure of 6½-7 inches of water as recommended in the folder we are supplied with only 4½-6 inches depending on the time of day. Temporary fluctuations can be partially controlled by either: a) having a new line brought into the building; b) by using the gas at a time when no one else in the building is drawing gas from the same line; c) by using other gas connections in close proximity sparingly; or d) by using propane gas as a separate unit.

Obviously, the first two suggestions are rather impractical, the third can be partially controlled, whereas the fourth has fire hazard implications. In practice, the problem is solved by first getting the best flame available for that time of day and secondly, simultaneously controlling the oxygen pressure and the "fine adjustment screw" located on the front panel of the instrument.

In our laboratory the gas pressure in the afternoon is usually less than in the morning. Therefore, we turn on the instrument at an oxygen pressure of approximately 8 lbs. and gradually bring the pressure up to 10 lbs. while simultaneously adjusting the fine adjustment screw to control the height of the "inner cone."

2. Distilled water supply—In some laboratories this problem may never arise since the water supply may not vary in impuri-

ties from week to week or from month to month. In our laboratory this is a very real problem since we obtain all of our distilled water from a metal still. There are several practical ways of solving this problem: a) an all-glass still can be purchased and can be watched carefully for the presence of impurities by constant checking; b) distilled water can be purchased commercially and the amount of impurities can be noted on the label and checked against subsequent batches; c) water can be run through ion exchange resins which yield highly purified water.

We solved the problem by simply making up a small amount (100 cc.) of the "100% Standard" and "0 Standard" with every new batch of distilled water which we obtain. In addition, we find it convenient to run a pooled control serum every day which does not vary more than 2.5 meq/1. of sodium or 1.7%, and 0.2 meq/1. of potasium or 3.5%.

This precaution has eliminated the constant complaint of staff members, to wit: "Your sodiums are a little elevated lately," or "Have you noticed that your sodiums are a little low this week?"

3. Collection of blood specimens—Many workers believe that it is best to collect blood with a syringe without stasis and to transfer the blood to a tube containing approximately 1.5 mg. of dried heparin, centrifuge the blood immediately and determine

SODIUM					POTASSIUM				
			Difference					Difference	
No.	Serum meq/1.	Plasma meq/1.	meq/1.	Percent	No.	Serum meq/1.	Plasma meq/1.	meq/1.	Percent
1	142.3	142.3	0.0	0.0	1	4.28	4.1	+ 0.18	+ 4.4
2	150.0	150.0	0.0	0.0	2	4.3	3.8	+ 0.5	+13.0
3	131.5	132.8	—1.3	—0.9	3	4.7	6.9*	— 2.2	—30.0
4	142.3	141.0	+1.3	+0.9	4	4.3	4.1	+ 0.2	+ 4.9
5	150.0	150.0	0.0	0.0	5	5.2	5.5	— 0.3	— 5.5
6	123.8	128.9	—5.1	—3.9	6	3.8	3.7	+ 0.1	+ 3.0
7	134.3	128.9	+5.4	+4.2	7	4.15	4.1	+ 0.5	+ 1.0
8	144.9*	144.9**	0.0	0.0	8	5.3*	6.1**	— 0.8	—13.0
9	141.1*	139.6**	+1.5	+1.0	9	4.9*	6.0**	— 1.1	—18.0
10	142.3	138.0	+4.3	+3.1	10	4.1	4.0	+ 0.1	+ 2.5
11	142.3	145.0	—3.3	—2.2	11	3.7	3.5	+ 0.2	+ 5.6
12	138.2**	139.6**	—1.4	—1.0	12	6.8**	6.6**	+ 0.2	+ 3.0
13	140.2	143.6	—3.4	—2.3	13	4.9	4.4	+ 0.5	+11.0
14	146.2	144.9	+1.3	+0.9	14	5.1	4.9	+ 0.2	+ 4.0
15	143.6	138.0*	+5.6	+4.0	15	4.4	6.6*	— 2.2	—33.0
16	146.2	147.0	—0.8	—0.6	16	5.4	5.3	+ 0.1	+ 1.9
17	137.0	142.0	—5.0	—3.5	17	4.1	4.1	0.0	0.0
18	144.9	144.9	0.0	0.0	18	4.7	4.7	0.0	0.0
19	146.0	146.0	0.0	0.0	19	4.7	4.8	— 0.1	— 2.0
Range: —3.9 to +4.2%					Range: —33.0 to +13%				

* Degree of hemolysis.
** Serum and Plasma on cells overnight.

TABLE I
Comparative Study of the Determination of Serum Sodium and Potassium vs. Heparinized Plasma Sodium and Potassium

the sodium, potassium, and calcium within an hour. In our hospital, blood is collected by clerks, internes, and residents. Visiting physicians also bring in blood specimens. In addition, we use vacuum tubes (Vacutainer*) instead of syringes to obtain blood by venipuncture. Since other tests are often requested along with the sodium and potassium it is desirable to perform them all on a single blood sample, if possible.

We therefore undertook a comparative study of the serum sodium and potassium determinations vs. heparinized plasma sodium and potassium determinations. The results are shown in Table I.

This series is small but from it the following impressions have been gained: first, that heparinized plasma looks slightly hemolyzed more often than does serum regardless of the method of collection. Second, that even though there is some hemolysis in the heparinized plasma or serum the potassium may not be markedly elevated. Third, the sodium, is essentially the same regardless of the method of collection of the blood.

Quite often we noted that a serum without the slightest trace of hemolysis will give a higher potassium value than expected. Invariably in such cases it has been found that the specimen was allowed to stand for some time before centrifugation. (Table II). This led to a study of the effects of prolonged contact of plasma or serum and red cells to determine the extent of the error involved. (Table III).

No.	Sodium meq/l.	Potassium meq/l.
1	126.2	8.5
2	142.3	7.4
3	....	7.7
4	126.2	8.5
5	131.5	8.5
6	151.2	11.0*
7	135.5	8.1
8	137.0	9.0
9	143.6	7.7
10	....	9.1
11	142.3	7.1
12	134.3	10.4*

* Estimated.

TABLE II
Unhemolyzed Serum Yielding High Potassium Values

Controls were also run. Ten cc. of blood was obtained and centrifuged within one half hour. Approximately 0.5 cc. of serum was carefully removed; the tube was stoppered and allowed to stand in the ice box at 5° C. for 18 to 24 hours; it was then recentrifuged and the serum was withdrawn from the cells. With-

*B-D Vacutainer No. 3200, Becton, Dickinson and Co.

SODIUM					POTASSIUM				
			Difference					Difference	
No.	A meq/l.	B meq/l.	meq/l.	Percent	No.	A meq/l.	B meq/l.	meq/l.	Percent
1	139.6	138.2	−1.4	−1.0	1	4.8	6.9	+2.1	+ 44
2	135.5	128.9	−6.6	−4.8	2	4.7	6.7	+2.0	+ 43
3	139.6	137.3	−2.3	−1.6	3	4.3	7.6	+3.3	+ 79
4	142.3	134.0	−9.3	−6.5	4	3.3	7.8	+3.5	+106
5	137.0	134.0	−3.0	−2.1	5	4.6	10.4**	+5.8	+126
6	138.2*	128.9*	−9.3	−6.5	6	5.6*	7.2*	+1.6	+ 33
7	127.7**	126.2**	−1.5	−1.1	7	6.8**	7.2**	+0.4	+ 6
8	138.2	132.8	−5.4	−3.9	8	4.8	6.4	+1.6	+ 33
9	142.3	142.3	....	0.0	9	5.9	7.0	+1.1	+ 19
10	143.6	143.6	0.0	0.0	10	5.6	8.7	+3.1	+ 55
11	137.0	134.3	−2.7	−1.9	11	4.9	6.6	+1.7	+ 35
12	131.5	134.3	+3.3	+2.5	12	6.1	7.3	+1.2	+ 19
13	144.9	....	....	....	13	3.9	7.0	+3.1	+ 80
14	139.6	139.6	0.0	0.0	14	5.2	6.8	+1.6	+ 31
Range: −6.7 to +2.5%					Range: +6 to +126%				

A = Serum removed within one-half hour.
B = Serum in contact with cells 18 to 24 hours.
* = Degree of hemolysis.
** = Estimated.

TABLE III

Study of the Effect of Prolonged Contact of Plasma or Serum and Red Cells

out exception the potasssium content of the plasma or serum which was allowed to remain in the cells for 18 to 24 hours was higher than the control series.

Our staff members and residents have been alerted to this important souree of error and are cooperating well in eliminating the cause.

Table IV shows results obtained from day to day on the same sample of serum or plasma. Their constancy shows that it is possible to save samples of serum or plasma or to send specimens through the mail provided they are centrifuged promptly and a rubber stopper is used. Cork stoppers are unsatisfactory for storage[5].

Discussion

Unexpected abnormally high potassiums, it is felt, may be due to the fact that when the cells remain in contact with the serum or plasma the potassium passes through the cell membrane into the serum or plasma. At the same time, a small amount of sodium probably enters the cells. This process can readily occur without hemolysis since as long as the cell membrane remains intact, the hemoglobin remains in the cell. On the other hand, only relatively few cells need to be broken up to produce hemolysis, so that when slight hemolysis occurs the amount of potassium added to the serum or plasma is relatively small.

Conclusions

The use of a flame photometer requires many precautions and controls before accurate and reliable results can be obtained.

SODIUM					POTASSIUM				
			Difference					Difference	
No.	A meq/l.	B meq/l.	meq/l.	Percent	No.	A meq/l.	B meq/l.	meq/l.	Percent
1	139.6	142.3	+2.7	+1.9	1	4.8	4.6	−0.2	−4.0
2	135.5	134.3	−1.2	−0.9	2	4.7	4.3	−0.4	−8.5
3	139.6	137.0	−2.6	−1.9	3	4.3	4.1	−0.2	−4.6
4	142.3	137.0	−5.3	−3.7	4	3.3	3.2	−0.1	−3.0
5	137.0	137.0	0.0	0.0	5	4.6	4.4	−0.2	−4.0
6	138.2	137.0	−1.2	−0.9	6	....	....	....	....
7	137.0	134.3	−2.7	−1.9	7	4.9	4.7	−0.2	−4.0
8	131.5	128.9	−2.6	−1.9	8	6.1	6.2	+0.1	+1.6
9	144.9	144.9	0.0	0.0	9	3.9	3.9	0.0	0.0
10	144.9	144.9	0.0	0.0	10	5.6	5.5	−0.1	−1.8
11	139.6	138.2	−1.4	−1.0	11	5.3	5.2	−0.1	−1.9
12	138.2	137.0	−1.2	−0.9	12	5.3	5.2	−0.1	−1.9
13	132.8	134.3	+1.5	+1.2	13	5.9	5.6	−0.3	−5.0
14	142.3	144.9	+2.6	+1.9	14	5.5	5.5	0.0	0.0
15	142.3	137.0	−5.3	−3.7	15	5.4	5.5	+0.1	+1.8
16	135.5	138.2	+2.7	+1.9	16	....	....	....	....
17	152.0	152.0	0.0	0.0	17	4.7	4.6	−0.1	−2.1
18	142.3	146.0	+3.7	+2.5	18	3.6	3.7	+0.1	+2.8
19	137.0	138.2	+1.2	+0.9	19	4.6	4.6	0.0	0.0
20	134.3	132.8	−1.5	−1.2	20	3.0	3.1	+0.1	+3.3
21	134.3	131.5	−2.8	−2.0	21	4.8	5.1	0.3	6.0
22	142.3	141.0	−1.3	−0.9	22	5.9	5.8	−0.1	−1.7
23	121.0	126.0	+5.0	+4.0	23	4.8	4.6	−0.2	−4.0
24	155.2	157.6	+2.4	+1.6	24	1.9	1.8	−0.1	−5.2
Range: −3.7 to +4.0%					Range: −8.5 to +6.0%				

A = Sodium and Potassium determined within two hours.
B = Sodium and Potassium determined 18 to 24 hours later.

TABLE IV
Serum Sodium and Potassium Determined Within Two Hours and After 18 to 24 Hours

Several practical problems have been presented and their solutions discussed.

Heparinized plasma may be considered superior to serum for the determination of sodium and potassium but in our experience serum is preferred provided the proper precautions are taken.

To remove the plasma or serum from the cells as soon as possible (within a half hour) is the most important thing to remember when determining a potassium.

REFERENCES

1. Weichselbaum-Varney Universal Spectrophotometer, Bulletin Number 151-A, Scientific Instrument Division of Fearless Camera Corp., Los Angeles, California.
2. Weichselbaum-Varney Universal Spectrophotometer, Manual of Operation and Maintenance, The Fearless Camera Corporation, Los Angeles, California.
3. Weichselbaum, T. E. Personal Communication.
4. Weichselbaum, T.E. and Varney, P.L., Proc. of the Soc. for Exp. Biol. and Med., 71:570, 1949.
5. Weichselbaum, T.E., Personal Communication.

LABORATORY PLANNING*

SISTER MARY OF MERCY J. O. M.
Sacred Heart Hospital, Manchester, New Hampshire

The rapid growth of the use of laboratory methods for the diagnosis and treatment of disease has made it necessary for nearly every laboratory to seek the enlargement of its physical set-up at some time or other during its development. This is commonly done:

1. By annexing adjoining rooms;
2. By remodeling a room which has been poorly arranged although the floor space may be adequate; or
3. By placing a new laboratory in a new building.

The responsibility for such adjustments and changes becomes the burden of the pathologist.

Our profession of Medical Technology, as a branch of service, is bound by a firm thread of helpful service to the pathologist. As a good medical technologist develops laboratory judgment through experience, it becomes possible for him to share with the pathologist not only some of the burdens of laboratory management; but also to contribute sound and practical suggestions in this matter of laboratory planning.

The medical technologist, if asked to offer suggestions regarding physical changes or improvements, should be quick to cooperate; recognizing that this might be his only chance to see his dream of a "model laboratory" a reality. And who is better suited to help with this planning than the one who spends his days in the laboratory?

In order to present a substantial working conception of a laboratory plan, the following information is essential:

1. The number and types of tests expected to be done in the new arrangement;
2. The maximum number of workers, including students, to be accommodated;
3. The amount of present equipment and a list of proposed additional apparatus;
4. A diagram of the floor space, showing the doors and windows.

With this information on hand, the very best working arrangement may then be drawn to-scale. Although perhaps crude, it should be complete with every detail, before it is presented. This

* Read before ASMT Convention, Swampscott, Mass., June 1951

plan may not be accepted or put into practice, but how many such plans have been set aside; only to be searched for frantically a year or two later?

When a room is to be remodeled by one who has worked in that room previously, care must be taken that the plans be drawn directly from the floor plan without considering previously placed sinks, centrifuges, etc.; as fixed physical factors. In reality, such elements are not fixed. If a sink or a centrifuge would be more serviceable in another location they *can* be moved.

Another fact to be considered is this. Although it is right and proper that the correction of the greatest flaw in the present working conditions be uppermost in the mind of the technologist, the laboratory as a whole must be visualized; and he must foresee where he may invent three minor faults to correct one major flaw.

Location

The actual location of the laboratory is a factor the medical technologist cannot control. The location of the departments within the laboratory, however, is quite another matter. In planning the department locations, those whose work demands contact with the hospital floors should be placed nearest to the doors, stairs, or elevators. For example—the bacteriology department should not be placed across the corridor from the elevator and the hematology department isolated away down the far end of the corridor. Then, too, the office handling the out-patients should be at the point where the public first steps on laboratory territory. This prevents the confusion which comes from patients strolling through the laboratory looking for information. Departments having common interests—such as the blood bank and serology; histology and pathology—should be located near one another.

Interchangeable Equipment

In some instances, especially in the smaller hospitals, it is necessary—although not recommended—for more than one department to share some of the larger pieces of equipment; such as refrigerators, centrifuges, incubators, and drying ovens. This equipment should be placed in the room where it is to be used most frequently and near enough to the door to prevent cross traffic annoyances and unnecessary distractions to the workers within the room.

Arrangement of Working Units

Nearly all laboratory planning may be said to be based on the elimination of unnecessary motion; since a minimum of motion is what is foremost in the mind of the one arranging the

individual working space. This requires a thorough knowledge of the equipment as well as the space needed to do each individual test. For this reason it is easier for a medical technologist than it is for any other person to arrange the working units, and he should study the arrangement as it will appear to him while doing the tests under a maximum "under-pressure" day. Care must be taken that there be provision made for proper and adequate light in the unit and that all possible cross-traffic be eliminated.

Placement of Personnel

The last factor to be considered in this brief overall study is to visualize the working personnel. Those, who of necessity, require some conversation and motion should be separated from those whose work requires more rigid concentration. Much of the fatigue at the end of the day, and the built-up tension over a period of years, is due to the constant forcing of the act of concentration against distractions in the immediate vicinity. One does not feel it at the time, but proof is demonstrated when distractions are removed.

The New Hampshire Society of Medical Technologists had placed in the Exhibit Hall a model Hematology Department* to illustrate the points brought out in this paper. It showed the medical technologists with conversation and motion separated from the workers that count cells. It placed the location of the department head in such a manner as to facilitate the proper communication with each section; thus maintaining the unity of the laboratory as a whole. Such an arrangement is adaptable to a wider or a smaller range depending upon the amount of work to be accomplished in the allotted space.

SUMMARY

1. When faced with problems of adjustment to laboratory arrangements and facilities, the pathologist should be able to receive efficient help from his medical technologist.
2. The Medical Technologist should present a to-scale drawing complete in every detail.
3. The drawing should indicate the placement of the departments, equipment, and supplies for the tests to be executed.
4. The plan should be studied out to eliminate all unnecessary motion and traffic.
5. The personnel should be so placed as to separate those requiring rigid concentration from those whose work has motion and conversation.

* Award; Exhibits (by State Society) ASMT Convention, 1951. Swampscott, Mass.

LIFE SPAN OF Rh_o ANTIBODIES

LESTER J. UNGER,† M.A., M.D.
From the Blood and Plasma Bank
New York University-Bellevue Medical Center, New York City

Three weekly intravenous injections of group O type MN Rh-negative freshly citrated whole blood from a female individual were given to an Rh-negative non-sensitized male volunteer who had never before received blood either intravenously or subcutaneously. Each injection consisted of 20 cc of whole blood collected in 10 cc of ACD solution to prevent coagulation. The donor had been sensitized by the Rh factor as a result of previous pregnancies. Examination of her serum by the saline agglutination method showed that Rh_o and rh′ agglutinins were each present in a titer of 4 units; by the albumin-plasma conglutination method the titer of Rh_o antibodies was 380 units and rh′ antibodies 256 units.

It has been shown that antibodies present in the serum of an Rh-negative baby, born of a sensitized Rh-negative mother, gradually diminish in titer and that only traces are demonstrable by the end of the fourth month.[1] Our investigation differs from the one referred to in that the exact amount of blood responsible for the passive immunity was known. It seemed worthwhile, therefore to study the life span of the antibodies passively transferred to this Rh-negative adult.

Specimens of the recipient's blood were collected before and after each injection and then examined for Rh antibodies. All titrations were done at least in duplicate using type Rh_1 and Rh_2 cells, and the average of the reciprocals of the highest dilution giving a distinct (one plus) reaction was taken as the titer. Type Rh cells were of course used as controls. Specimens of the recipient's blood were drawn and examined at intervals from November, 1949, to October, 1950, to study their life span. The results of these tests are shown in Table I.

All tests carried out on the recipient's blood taken prior to the first injection failed to show any Rh or hr antibodies. After the first injection, antibodies were not detectable in the recipient's serum either by the saline agglutination, the albumin-plasma[2] and trypsinated cell*[3] or indirect antiglobulin[4] titration methods. However, when this latter test was carried out using cells which previously had been treated with trypsin, Rh_o antibodies were detected in a titer of 1 unit. This trypsinated cell indirect antiglobulin test** was used in this study because it has been shown

† Director Blood and Plasma Bank, New York University Bellevue Medical Center. Attending physician, University Hospital, New York City.

to be more sensitive than any other.[5] The fact that the specificity of antibodies in the injected blood had been definitely determined, finding in the recipient's blood antibodies of the same specificity, together with negative control tests, established this test in this case as specific.

After the second and third injections the concentration of Rh_0 antibodies in the recipient became such that by the albumin-plasma method the titer was 4 units. Since a total of 60 cc in terms of donor's whole non-citrated blood had been injected, approximately 36 cc of plasma containing antibodies had been administered. Assuming that the recipient's plasma volume was 3000 cc the mere mixture of his plasma with that which was injected would result in a titer (albumin-plasma method) of approximately 7 units for anti-Rh_0 and 4 units for anti-rh′. The titers actually obtained were somewhat lower, yet closely corresponded to the calculated titers. Each specimen of blood for titration was drawn approximately one week after the previous injection and it is possible that there was some loss in the body tissue fluid. None of the titrations demonstrated antibodies by the saline method, obviously because they were present in too low concentration. As determined by the albumin-plasma method, the titer of Rh_0 univalent antibodies was unchanged for a period of 44 days when it gradually fell. Antibodies were still present at the 88th day in a titer of 1 unit but were no longer detectable by the albumin-plasma method after 141 days. Yet they must have been present in the circulation because as late as the 189th day they were detectable by the trypsinated cell method. Unfortunately the summer months intervened, the recipient was not available, and no examinations were made until the 319th day when antibodies were no longer detectable by any of the methods used.

It is recognized that at no time was the antibody titer high, nor could it be, because only a small amount of sensitized blood had been injected. Admittedly, the variation of titration results of one tube is not significant, yet all tests in this experiment were done "blind"*** and the reduction in titer was progressive and therefore can be considered significant.

As a result of this experience, the serums of all Rh-negative

---

*The cells were washed very thoroughly three times in normal saline solution and then packed. To nine parts of packed cells, one part of a 1% trypsin (Difco) in standard buffer solutions was added, mixed and placed in a water bath at 37° C. for one hour. They were washed once in normal saline and a 5% suspension in normal saline was next made and used for titration as in the standard saline agglutination method.

**This test is carried out in the same fashion as the indirect antiglobulin titration (Coombs) except that the test cells used are treated with trypsin instead of using untreated cells.

***The word "blind" indicates that all titration readings were made with no knowledge of the nature of the serum titrated until after the reading had been made.

donors at our Blood Bank are tested for Rh antibodies and some offering their blood for transfusion have been found to be sensitized. The blood of one such donor had Rh_o antibodies present in a titer of 128 units. While the number of such donors is relatively small, it seems wise not to release such blood for transfusion because some physicians, in an emergency, use for patients whose Rh factor is unknown, group O Rh-negative blood without crossmatching. Under such circumstances, if the donor's blood contains Rh antibodies in sufficiently high titer and the patient is Rh-positive, an untoward reaction might conceivably result. This would be comparable to transfusion of high titered group O blood to Group A, B or AB patients. In addition, if the patient is Rh-negative and pregnant, passive sensitization with possible damage to the fetus might conceivably follow especially since, as shown in this study, these antibodies persist in the circulation for a considerable period.

Conclusions

The life span of Rh_o univalent antibodies passively transferred to a non-sensitized Rh-negative adult male was studied. Both the amount of blood given and the titer of the antibodies present was known. These antibodies gradually disappeared from the circulation although they were still detectable by the albumin-plasma method for at least 88 days after injection, and by the more sensitive trypsinated cell method after at least 189 days. They could no longer be demonstrated in a blood specimen collected on the 319th day.

While it is recognized that by the newer revised methods for crossmatching, antibodies should be detected unless present in a titer less than 1 unit, there are occasions when this test is omitted. It has become the practice of some to transfuse, in an emergency, group O Rh-negative blood without preliminary crossmatching. This practice is unwise as well as uneconomical. Although in the ordinary course of events the chance that an Rh-negative donor will show signs of Rh sensitization is minimal, recently that chance has increased. An ever increasing number of Rh-negative blood donors are being immunized for the production of diagnostic anti-Rh serum and some then present themselves as donors of blood for transfusion. The titer of Rh antibodies in some of these donors has been found to be very high, and it is conceivable that transfusion of such blood to an Rh-positive patient might be followed by an untoward reaction. In the event that Rh-negative blood containing Rh antibodies is transfused to an Rh-negative mother whose fetus is Rh-positive, such passive sensitization might unfavorably affect the fetus. It seems wise, therefore, that blood banks test the blood of all

Rh-negative donors for the presence of Rh antibodies before releasing it for transfusion.

BIBLIOGRAPHY

1. Wiener, A. S.: Rh Factor in Immunological Reactions. Annals of Allergy. Vol. 6, pp 293-304, May-June 1948.
2. Wiener, A. S., (1945): Conglutination Test for Rh Sensitization. J. Lab. and Clin. Med., 30, 662-667.
3. Morton, J. A.,and Pickles, M. M. (1947): Use of Trypsin in the Detection of Incomplete Anti-Rh Antibodies. Nature, Lond., 159, 779.
4. Coombs, R. A. A., Mourant, A. E., and Race, R. R. (1945): Detection of Weak and "Incomplete" Rh Agglutinins: A New Test. Lancet ii, 15.
5. Unger, L. J.: A Method for Detecting Antibodies in Extremely Low Titer. The Journal of Laboratory and Clinical Medicine. May, 1951, Vol. 37, No. 5, p. 825.

A MICRO TECHNIQUE FOR PROTHROMBIN TIME

JEANETTE SANDUZZI, B.A., M.T. (ASCP)
The Mountainside Hospital, Montclair, New Jersey

Because of the extensive therapeutic use of dicumarol in thromboses and cardiac cases, many patients require daily prothrombin times for proper drug administration. Since venous blood has been necessary for this test, difficulty may be encountered in obtaining daily samples, after many weeks of punctures.

Secondly, we have had occasions where prothrombin times were requested on jaundiced babies, which presented a problem. To obtain sufficient blood that wasn't clotted, many punctures were usually necessary. Frequently the test had to be cancelled through failure to obtain a satisfactory sample. Therefore, it has been felt that a simple accurate micro technique in such cases would solve our problem. This has been accomplished by modifying the standard Quick Technique for prothrombin times. A series of comparisons of the standard venous technique and this micro technique has been made, and the results have proven very favorable.

Procedure

Materials:

1. A 0.2cc Folin Micro Sugar Pipette.
2. 75 x 10 mm. test tubes.
3. Thromboplastin extract, 0.1M Sodium Oxalate Solution, and 0.02M Calcium Chloride Solution, as used in the Quick Technique for prothrombin times.

Method:

1. Into a 75 x 10 mm. test tube place 0.02ml of 0.1M sodium oxalate solution.
2. In the same manner as taking a hemoglobin, from a finger puncture obtain quickly 0.2ml. blood with a 0.2ml. micro pipette and mix with the sodium oxalate solution in the test tube.
3. Centrifuge the oxalated blood and remove the plasma with a fine capillary pipette and place in a small test tube.
4. Into a 75 x 10 mm. test tube transfer 0.05ml. plasma, add 0.05ml. thromboplastin extract, mix, and place in a 37° C. water bath for a few seconds.

---

* Read before ASMT Convention, Swampscott, Mass., June, 1951.

COMPARISONS OF VENOUS AND MICRO PROTHROMBIN TIMES

No.	Date	Patient	Venous Method Time in Sec.	Micro Finger Method, Time in Sec.
1	6/30/50	Control	15 sec.	16 sec.
2	6/30/50	Baby X	None obtained	14 sec.
3	7/ 3/50	Control	13 sec.	13 sec.
4	7/ 3/50	Baby Y	None obtained	13 sec.
5	7/ 5/50	*Patient A	32 sec.	32 sec.
6	7/ 7/50	*Patient A	21 sec.	22 sec.
7	7/12/50	*Patient A	21 sec.	20 sec.
8	7/ 6/50	Patient B	15 sec.	15 sec.
9	7/ 7/50	*Patient C	46 sec.	46 sec.
10	7/10/50	*Patient C	21 sec.	21 sec.
11	7/12/50	*Patient C	21 sec.	21 sec.
12	7/ 7/50	Patient D	13 sec.	13 sec.
13	7/ 7/50	Patient E	14 sec.	13 sec.
14	8/24/50	Patient F	15 sec.	15 sec.
15	8/24/50	Patient G	19 sec.	19 sec.
16	9/20/50	Baby Z	None obtained	11 sec.
17	10/ 5/50	*Patient H	14 sec.	14 sec.
18	10/10/50	*Patient H	37 sec.	38 sec.
19	10/ 6/50	*Patient I	42 sec.	43 sec.
20	10/11/50	*Patient I	27 sec.	26 sec.
21	10/14/50	*Patient J	36 sec.	35 sec.
22	10/16/50	*Patient J	29 sec.	27 sec.
23	1/ 4/51	*Patient K	32 sec.	31 sec.
24	1/ 5/51	*Patient L	20 sec.	20 sec.
25	1/18/51	*Patient M	36 sec.	36 sec.
26	2/20/51	*Patient N	37 sec.	37 sec.
27	2/21/51	Patient O	15 sec.	15 sec.
28	2/28/51	Patient P	13 sec.	13 sec.
29	3/ 1/51	*Patient Q	20 sec.	20 sec.
30	3/ 2/51	*Patient R	26 sec.	26 sec.
31	3/ 6/51	*Patient S	34 sec.	34 sec.
32	3/ 6/51	Baby W	None obtained	17 sec.

* Refers to patients known to be receiving dicumarol.

5. Add 0.05ml. 0.02M calcium chloride solution and start the stop watch. Keep the tube in the water bath and shake lightly. Then by gently tilting the tube observe the formation of the clot. Stop the stop watch. The time elapsing between the addition of the calcium chloride and the end point is the prothrombin time.

Note:

If the patient's finger is bleeding freely and enough blood is obtainable, 0.4ml. of blood may be mixed with 0.04ml. sodium oxalate in a 75 x 10 mm. test tube. In which case, 0.1ml. of plasma can be withdrawn and the test conducted in the same proportions as in the venous method of the Quick test. This larger

amount of blood is obtainable in most adult cases. In babies the toe or heel may be used if preferred.

Precautions:

1. Undue squeezing of the finger must be avoided as some tissue fluid would then be mixed with your blood sample.
2. All other precautions described under the Quick test must be adhered to also.

Summary

This paper describes a simple and accurate micro technique for prothrombin times. A comparative study shows that this method has an accuracy of plus or minus one second, with 18 cases out of 28 giving the same value. Only one case in this series varies as much as two seconds. This method has proven of value in difficult venous cases, children and babies, where prothrombin times were necessary but where venous blood could not be easily taken.

While we use Difco thromboplastin in our laboratory, this micro technique can be applied to any thromboplastin in common use, where the Quick method is utilized. If desired a prothrombin activity curve can be constructed and the micro prothrombin time reported in percentage of activity instead of in seconds as this hospital does.

REFERENCES

1. Hepler, "Manual of Clinical Laboratory Methods," Fourth Edition. Charles C. Thomas, 1949. P. 86.
2. Kolmer and Boerner, "Approved Laboratory Technique," Fourth Edition, D. Appleton Century Co., 2945. PP. 101-102.
3. Difco Manual of Dehydrated Culture Media and Reagents for Microbiological and Clinical Laboratory Procedure, Eighth Edition. Difco Laboratories Incorporated, Detroit, Michigan, 1948. PP. 207-211.

VIRAL HEPATITIS: AN OCCUPATIONAL HAZARD TO MEDICAL TECHNOLOGISTS*

By SYDNEY S. GELLIS, M.D.
The Children's Hospital, Boston, Mass.

The purpose of my talk today is two-fold: I wish to emphasize to you (1) the importance of hepatitis as a hazard to workers dealing with human blood and blood products and (2) the importance of the medical technologist in the spread of this disease. Viral hepatitis is usually considered to be two diseases, known as infectious hepatitis and homologous serum hepatitis. It is with the latter that we are chiefly concerned today. Infectious hepatitis is an ancient disease, whereas homologous serum hepatitis is relatively new, dating from the time when the administration of human blood and blood products first began. Infectious hepatitis in epidemic form occurred during Napoleon's Campaign in Africa, and extensive epidemics in military personnel were recorded during the Civil War in this country, the Boer War in South Africa, and in World Wars I and II. Studies conducted during World War II on the naturally occurring disease resulted in several relatively new concepts, namely: (1), infectious hepatitis is a disease we have always termed catarrhal jaundice; (2), it occurs frequently as hepatitis without jaundice; (3), it is caused by a virus; (4), it may cause sudden death; (5), it may be chronic; 6), it may explain cases of cirrhosis previously considered to be of unknown etiology.

Similarly, a historical review of homologous serum hepatitis is worthy of consideration. This disease was first described by Lürman in 1885 in a report of an outbreak of jaundice among workers in a Bremen shipyard who had been vaccinated with a vaccine containing human serum. From one to seven months after vaccination one hundred and ninety-one of twelve hundred and eighty-nine persons became jaundiced while five hundred other workers in the same shipyard vaccinated with a different lot of serum remained free of the disease. No further report of jaundice following the use of human serum appeared until 1937 when Bradley reported, and I quote from him, the following episode: In May 1937 the two children of a family living near Oxford, England, died on consecutive days of acute yellow atrophy of the liver. Four days before death one child, a girl aged seven, vomited after breakfast but was able to travel with her mother to London and back by train. She vomited again after returning home and was restless during the night. On the second day she was at first sleepy but later irritable; the restlessness became marked and she complained of some abdominal

* Read before ASMT Convention, Swampscott, Mass., June 1951

pain. Her doctor found no signs of physical disease and the mother chastised the child for screaming and behaving irrationally. The next day the condition changed dramatically, the child vomited altered blood, became uncontrollable, and for the first time was noticed to be slightly jaundiced. She died 24 hours later after a period of coma with marked neurological signs. The 4½ year old brother's illness began the day after his sister's and ran an almost identical course. Their nurse also developed jaundice but survived. During an inquiry by medical officers to the British Ministry of Health it was learned that within a month two other young children in Oxford had died similar deaths and that all four and the nurse had received injections of a single batch of measles convalescent serum nine or ten weeks previously. Eventually 109 recipients of this batch of serum were traced; 41 scattered over widely separated areas in England subsequently became ill, 37 of them were jaundiced and eight died of acute yellow atrophy—a fatality rate of twelve percent. All died between the 61st and 93rd day after receiving serum.

A similar sequence of events following the administration of yellow fever vaccine was reported by Findley and MacCallum in 1937 and 1938, who in five years had vaccinated 3100 persons, 89 of whom developed hepatitis two to seven months later. They were satisfied that the hepatitis was not due to the yellow fever virus itself but suspected contamination with some agent during tissue culture involving the use of human serum.

At this point other similar experiences became available. In 1939 injections of active pappataci virus and convalescent serum were given to three hundred and fifty persons in a sandfly fever area on the Black Sea coast. Only one-hundredth of a cubic centimeter of serum was contained in each injection. Ninety-two of the patients developed jaundice between the 85th to 95th day after injection.

The American Red Cross-Harvard Field Unit in England, in attempting to prevent mumps in a unit of the British Tank Corps, administered convalescent mumps serum which produced hepatitis in 44.7 per cent of the men, 44 to 122 days later.

The disease which had been occurring following the use of human serum contained in various types of vaccines appeared to be similar to the disease called jaundice with mad staggers which had been reported in large herds of horses during the course of immunization with antigens which were administered in horse serum. Because of the similarity, the condition was called homologous serum hepatitis, a hepatitis characterized by a long incubation period of from two to four months following administration of blood from the same species.

Meanwhile in the United States after Pearl Harbor all troops received inoculations of yellow fever vaccine which contained

human serum, and a large epidemic of hepatitis made its appearance beginning in March 1942. It soon became clear that the yellow fever virus was not responsible for the jaundice since only certain lots of the vaccine were incriminated. Only nine out of one hundred and seventeen lots which were investigated were found to be responsible for 23,664 cases of hepatitis in the army. By pure chance the United States Navy had only 691 cases in 1,645,740 men inoculated and the discrepency became clear when it was discovered that the Navy had been supplied with only a small part of one highly icterogenic lot of vaccine.

The differentiation between the two diseases which we have discussed, infectious hepatitis and homologous serum hepatitis, may be a difficult one. If the patient with hepatitis has a history of having received an injection of blood or plasma within a few weeks of developing hepatitis, he is considered to have homologous serum hepatitis. This diagnosis may become quite certain if other patients receiving blood from the same donor or plasma from the same pool have developed the disease. If, however, there is no history of an injection of any type prior to the onset of the disease, the patient is considered to have infectious hepatitis. There is at the present time no laboratory method which definitely distinguishes between the two diseases and since no laboratory animal has as yet been shown to be susceptible to hepatitis virus as it occurs in man the only method of studying the two diseases has consisted of the use of human volunteers. On the basis of extremely limited work with such volunteers it appears that the incubation period of infectious hepatitis is a relatively short one whereas the incubation period of homologous serum hepatitis is a long one lasting anywhere from two to six months. The experimental work which has been done in this field also suggests that virus is present in the blood stream of patients with either infectious hepatitis or homologous serum hepatitis although the total length of time in which the virus stays in the blood has not been fully determined in either type of disease. Furthermore, virus may be found in the stool specimens of patients with infectious hepatitis whereas virus has not been demonstrated in the stools of patients with homologous serum hepatitis. Despite the latter finding it is always wise in dealing with a patient in whom a diagnosis of hepatitis has been made to consider that both blood and stools contain virus since in the individual case one cannot definitely prove which disease is present.

Now that we have reviewed the nature of the disease known as hepatitis let us sum up the responsibility of the medical technologist in the prevention of this disease in himself and in hospital patients. It should be borne in mind that the virus which causes hepatitis is a very resistant virus. Exactly how much

heat is required to destroy hepatitis virus is unknown; it is therefore unwise to depend upon anything less than autoclaving or boiling of needles, syringes or other equipment. No reliance should be placed on the use of antiseptics for the destruction of the virus.

The medical technologist should use an individual needle and syringe for each patient, since there is no way of knowing which patients have virus in their blood and which do not. The needle and syringe should be sterilized by autoclaving or boiling. The quantities of blood necessary for transmission of the virus are minute and even tatooing needles have been incriminated in the spread of the disease. In obtaining capillary blood for blood counts and smears an individual needle should again be used for each patient. By carrying out these simple measures the transmission of this disease via the medical technologist can be eliminated. Now as to the need of the technologist to protect himself. Great care should be used to prevent being scratched by the points of the needles used in drawing blood and in preventing lacerations and scratches from glassware used in the testing of blood or plasma. Such accidents most frequently occur in the cleaning of needles and syringes and perhaps the wisest course is to accumulate used needles and syringes and boil them prior to cleaning them. The use of gloves in the handling of contaminated needles and syringes will not protect against such accidents and may merely offer a false sense of security. Stool specimens from patients with hepatitis must also be handled with extreme caution since virus may be present. Indeed all precautions should be doubled when dealing with the patient known to have or suspected of having hepatitis and it should be the responsibility of the physician in charge of such patients to label clearly all specimens sent to the laboratory with a notice to the effect that the patient has hepatitis and hence is a potential risk to the technologist. In some states the disease is now considered an occupational disease among medical technologists, with disability compensation granted to those who become ill with jaundice.

What may the laboratory worker do who accidently jabs his finger with a needle which was used to draw blood from a patient known to have hepatitis? At the moment the only available method of treatment is to be given an injection of gamma globulin once a month for two to three injections. The evidence that this will help prevent hepatitis is not clear; however the globulin will do no harm and may offer protection.

In one commercial laboratory engaged in the production of blood products all workers are receiving a prophylactic injection of gamma globulin once a month in the hope of preventing the disease.

A few words should be devoted to the treatment of this disease. The diagnosis is usually suspected when the patient complains of loss of appetite, pain over the liver, clay colored stools, and dark urine. Examination reveals an enlarged and tender liver. At about this time the jaundice makes its appearance, first in the sclerae and then in the skin. Before jaundice appears several liver function tests may be positive; these consist of the cephalin-cholesterol flocculation, bromsulphalein excretion test, thymol flocculation, and appearance of bile in the urine. Subsequently the serum bilirubin rises. While the disease is active all these tests continue to be positive. They return to normal in a somewhat reverse order: Bile disappears from the urine, serum bilirubin returns to normal, the cephalin-cholesterol flocculation test becomes negative, bromsulphalein returns to normal and finally the thymol flocculation and thymol turbidity tests become negative.

Prior to World War II the patient with this disease was allowed to return to activity as soon as jaundice had cleared. Studies during World War II pointed out the need of considering the disease at an end only when laboratory tests had returned to normal. At present it seems wise to allow the convalescing patient to try limited activity for a brief period, repeating the tests after such activity to make certain that these have not become positive. Finally, important factors in the treatment of the disease consist of the high intake of food with special emphasis on protein, and the observance of strict bed rest during the active stage of the disease.

In closing, here is a disease whose control may lie largely in the hands of the laboratory worker. Furthermore, this disease has proven to be a real danger to the worker himself. By proper precautions and careful technique on the part of the medical technologist danger to patients and to himself will be greatly reduced.

THE IMPORTANCE OF THE TRAINED LABORATORY ANIMAL ATTENDANT*

By C. N. W. CUMMING and F. G. CARNOCHAN
Carworth Farms, Inc., New City, Rockland County, New York

For the purpose of this paper the term "animal attendant" may be defined as a person who actually takes care of animals, cleans their quarters, feeds them and, most important, keeps them under observation. This holds true whether that person be the experimentalist himself, a technician or a laborer with no duty other than that of animal care.

There are several kinds of animal colonies. These differ somewhat from each other in the amount of care required. First, there is the short term colony, in which the animals are to be used for only a few days and in which the requirement is merely that the animal chosen should be healthy; second, is the long term experiment in which the animals may remain for months under the animal attendant's care. This is much more difficult to manage. Third, the breeding colony, from which production is required, is a very intricate affair indeed.

A successful breeding colony depends on several essentials. The foundation stock must be fertile, healthy and able to produce the type of animals that are required. The diet must be designed to give an adequate level of nutrition. Comfortable housing with adequate ventilation and temperature control must be provided. Most important, a high degree of sanitation must be maintained. The last requirement is the one with which the attendant is usually directly concerned, and the success or failure of the colony depends on the degree of sanitation achieved.

Thorough Cleanliness

The attendant has to be trained in the fundamentals of cleanliness. It is not sufficient that he knows how to feed and water the animals and that he has learned to clean a cage thoroughly, leaving no dirt behind in the corners. He must also know enough about the principles of sterility to disinfect or sterilize the cages and their fittings, and to clean cage racks, floors and walls with maximum effect. These sanitary procedures become partially ineffective if the attendant himself is habitually dirty. He has to be indoctrinated in clean personal habits, such as not expertorating in waste containers, on the floors, or anywhere in the animal quarters. This includes frequent washing of the hands, especially after handling animals which appear in any way to be abnormal, and the use of frequent changes of outside clothing. He must be made conscious of the importance of illnesses in himself, especially those of purulent, respiratory or

(Note: This paper was originally presented by Mr. C. N. W. Cumming at the first national meeting of the ANIMAL CARE PANEL at the University of Chicago.)

* Reprinted by permission from the Bulletin of the National Society for Medical Research, for July-August, 1951.

enteric character, so that it may be determined whether he has temporarily become a hazard to the health of the colony, and, therefore, must be excluded from it.

The attendant should be able to recognize at a glance the various insects which may infest a colony via the bedding, the feed sacks and on the clothing of visitors, or that which arrives under its own propulsion, such as the common fly. He should have instructions on the use of the insecticides most effective in controlling them. Many of the best agents for this purpose are toxic to animals if used improperly, and the techniques of application are of great importance. In all types of colonies, wild rodent excreta is an abomination because these animals carry many diseases and parasites which adversely affect all laboratory animals. The attendant consequently has to watch for signs of contamination of cages, food, and bedding by wild rodents.

An attendant can be instructed in all these things but mere instruction is insufficient. He must be so drilled in, and indoctrinated with, the importance of his work that all the measures of sanitation in which he has been instructed become habits which are practiced without conscious thought. This obviously cannot be accomplished in a short time. In some instances at least a year is required before the proper habits become fully established. In other instances this goal may never be achieved.

Should Detect Disease

Many operators of colonies consider the word "sanitation" in the narrow sense of cleanliness, but from the standpoint of the animal attendant the word has a much broader meaning. Disease is a natural phenomenon and can never be completely eliminated from a colony, except perhaps from such as the sterile colonies of Reynier's at Notre Dame University. The prompt recognition of diseased or defective animals, and their immediate elimination, is the most important part of the sanitation of a colony.

It follows then that the prime requirement of a good animal attendant is the ability to observe and to recognize any departure from the normal in the appearance of the individuals in the colony. This would seem to be a very simple qualification. Actually, it is exceedingly difficult to find attendants who are able to recognize what they are seeing. In urban areas especially this is true. Men who have been brought up in the country usually possess this trait to a much greater degree. It is an ability which it does not seem possible to teach. An attendant who possesses it can be taught what to look for and will learn the fundamentals in a short time. He will progress steadily with longer experience. If he has worked at length with one species of animal, he learns very rapidly to familiarize himself with different species. He becomes what may be called a good

animal man. One who does not possess it, even though hard working and conscientious in every respect, will never have the qualifications necessary to handle a breeding colony. He may be useful, however, in short term colonies, where the principal requirement is plain labor.

We have seen many attendants who have worked for years with a single species of animal, who were unable to see differences from normal in the behavior and appearance of the animals until these were so marked that the animals were almost moribund. No matter how conscientious about cleanliness and nutrition these attendants were, epidemics and disease would follow them from colony to colony because they were unable to detect trouble at its incipience. Only when the damage was so extensive that any one could see it did they notice it, too late for preventive measures to be taken. It is very much easier to control disease at its beginning than to attempt to eliminate it when it is well established.

Love For Animals

One little recognized factor in the care of animals is a genuine love for them. This should not be confused with the maudlin sentimentality of the antivivisection faction. Neither should it be assumed that an unintelligent love is sufficient; it is rather an understanding of animals to the extent that one recognizes their happiness and well being under certain conditions. The importance of this factor is well illustrated by a woman college graduate who maintains colonies of many different species under the same very dilapidated roof. The animals often seem overcrowded and obviously have not been cleaned for weeks. They are kept comfortable by the addition of fresh layers of bedding over the soiled underlayers. On several trips to this establishment we have yet to observe a sick animal or one that could not be handled with ease. Our explanation for this paradox is that this woman has a great love for animals. She is able to keep them healthy by her sensitive recognition of any abnormality in her charges with their subsequent elimination. So important is this love of animals factor that it might well be placed at the head of the list of requirements for a good animal man. A fair amount of intelligence and a respect for knowledge are important but secondary factors.

Duties Broad in Scope

Only the attendant sees all the animals in a colony at regular intervals and dependance must be placed on him to eliminate all animals which depart from the norm. He must be depended upon to recognize the gross symptoms of disease, even those with which he is not familiar and on which he has had no instructions. He must be cognizant of the importance of reporting

such symptoms for immediate study and diagnosis. What he reports may prove to be unimportant, but on the other hand such a report may save a colony from destruction.

It is necessary to use this power of observation for a purpose having no connection with sanitation. This involves the nutrition of the colony, especially of the stock which is used for breeding. For example, the volume of food needed for pregnant mice is almost double that necessary for males and non-pregnant females. The observing attendant notes immediately if insufficient food is being supplied and how much additional food should be furnished to a cage so that none remains uneaten long enough for it to spoil. There are other species, such as the rabbit, which do not breed well or fail to breed if they are too fat. Here production depends in part on the ability of the attendant to detect signs of over-feeding in the individual animals and much of the success of the colony depends on his interest and judgment in this respect. For experimentation over-fat animals are usually undesirable, and the attendant should watch closely the condition of the animals with reference to the intake of food. Such observation should be continuous since the amount of food required varies from day to day. This is also true of dogs and opossums, which tend to become over-fat when overfed and closely confined.

Animals Sensitive to Handler

The attendant who is afraid to handle the animals for which he cares never becomes a satisfactory one. Many species react strongly to fear or nervousness in the attendant, and become difficult to handle. If they cannot be freely handled it is difficult to inspect them carefully, and one part of the attendant's duty is to gentle his animals and get them accustomed to close examination. In many breeding colonies the change of an attendant, even though the replacement is a skilled man, causes a noticeable loss in production until the animals become familiar with the new caretaker. This effect seems less obvious with guinea pigs, but this may be only seemingly so due to the longer period of gestation of this animal, so that the effect of change is spread out over a much longer period.

Attendants may also have to be trusted with the keeping of some of the simpler records such as those of deaths, missing animals (escapes) and numbers of young animals produced by units of production. The death records can best be handled by the attendant since he is the only person having every animal in the colony under constant supervision.

It can be seen from the list of requirements and duties that the excellence of an attendant is the key to the successful operation of an animal colony.

THE ISOLATION OF PATHOGENS IN SUSPECTED FOOD POISONING*

By ADABELLE NOYES, M.T. (A.S.C.P.)

Medical Technician GS-6 Civilian, Bacteriology Section, Sixth Army Area Medical Laboratory, Fort Baker, California

Sizable investments are made in equipment designed for effective food protection and food handlers are becoming increasingly aware of their position regarding the health of the public. Food poisoning is decreasing but more emphasis is being placed on its epidemiology. The sources are narrowed down to a few and these are being studied by manufacturers, food processors and sanitarians. Laboratories should evaluate their procedures and include those which will give information as promptly as accuracy will allow.

Samples of the suspected food should be submitted to the laboratory promptly and with as little contamination as possible. Specimens which are to be delayed in delivery should be refrigerated. The food samples should be accompanied by a short description of the patient's symptoms and other available pertinent information.

The procedure described here is designed to enable the laboratory to give at least a presumptive identification of the offending organisms forty-eight hours after receipt of the specimen. The media employed are Modified Chapman-Stone agar,[1] Eosin-Methylene-Blue agar, SS agar, Trypticase Soy broth, and fluid Thioglycoliate. All of the media are available in dehydrated form with the exception of the Modified Chapman-Stone medium which will be described later in this paper. Direct smears of the suspected food are made, stained with Grams and observed for types and numbers of organisms present. These findings will often give an indication of the degree of contamination and are significant in interpreting the final results. Representative portions of solid food are ground with a mortar and pestle using sterile sand and sterile saline. Plates of the Modified Chapman-Stone medium are streaked heavily with the prepared material. These plates are incubated at 30° C. for exactly forty-eight hours. Bottles containing 50 ml Trypticase Soy broth and tubes of fluid Thioglycollate are inoculated with the suspected material and are incubated at 37° C. After twelve to eighteen hours incubation EMB and SS agar plates are streaked from the Trypticase Soy broth in a manner to insure some isolated colonies. These plates are incubated at 37° C. overnight.

The Chapman-Stone plates are examined at the end of the forty-eight hour incubation period for the presence of orange pigmented colonies surrounded by a clear zone, the latter being the positive gelatinase or Stone reaction. This medium is so

* Read before ASMT Convention, Swampscott, Mass., June 1951

inhibitory to other bacteria that it is possible to obtain relatively pure cultures of Staphylococcus and to demonstrate the presence of this organism which may be overgrown on blood agar plates. With this medium pigment production is more intense, the coagulase reaction is enhanced and the fermentation of mannitol can be demonstrated. If suitable isolated colonies are not obtained on the original plates additional subcultures may be made to other Chapman-Stone plates, however this is not usually necessary. Assuming that a satisfactory growth of Staphylococcus has been secured on the original plates further confirmatory tests are made.

To apply the coagulase test (Dienst[2]), collect as much of the culture as can be retained in a platinum loop and place in a Kahn tube containing 0.10 ml Brain Heart infusion broth. The tube is shaken for fifteen minutes, preferably in a shaking machine, 0.20 ml of a suitable rabbit plasma is added and the tube is incubated at 37° C. In most instances a positive reaction can be observed in twenty to thirty minutes. The test is discarded after two hours. Acid production from mannitol is determined by placing a drop of bromcresol purple, 0.04%, on an area of the plate where organisms were removed for the coagulase test. A change in color from that of the surrounding medium shows that fermentation has taken place. At this point it can be reported that a Staphylococcus producing an orange pigment, gelatinase positive, coagulase positive and fermenting mannitol has been isolated. An enterotoxin for animal studies may be prepared but in many laboratories this is not practical. Many authorities now accept the foregoing criteria as being sufficient for the identification of enterotoxin producing Staphylococci. When these organisms are present in large numbers on the plate streaked directly with the suspected food it may be presumed that sufficient Staphylococcus contamination existed in the food under study to have produced the enterotoxin. When food handlers are examined as possible carriers of Staphylococci the same medium may be used and the swabs are streaked directly on the plates and studied as described.

A study of the EMB and SS agar plates is made and the presence of both lactose and non-lactose fermenting organisms is noted. Coliform bacilli are reported when present as their presence may indicate faulty food handling or storage. Non-lactose fermenting organisms are subcultured on Kligler's Iron agar slants and the reactions noted after eighteen hours incubation. A serological screening may be made with antigen prepared from the slant after suitable subcultures have been made. Shigella and Salmonella organisms may be identified with group anti-sera on a presumptive basis at this point. Such presumptive identification should be made with caution inasmuch as some

Salmonella strains do not conform to their classic description and some Paracolobactrum have somatic antigens in common with the Salmonella. The use of Felsenfeld's Triple Sugar semi-solid medium[3] is helpful in eliminating the paracolon group and the use of one of the urea media is useful in identifying organisms in the Proteus group. Neither of these eliminate the necessity for a careful biochemical study of the organism before it is finally identified. Many laboratories are not prepared to carry out a complete serological study of the Shigella and Salmonella organisms in which case specimens may be submitted to one of the enteric typing centers.

Botulism, the most pathogenic of the food poisons is fortunately becoming rare but when symptoms are suggestive, the possible presence of this toxin must not be overlooked. Since minute quantities of the toxin may induce severe symptoms it is sometimes necessary to study the original food for the toxin in addition to attempted isolation of the organism as described by Dack.[4]

The Modified Chapman-Stone Medium is prepared as follows: The ingredients below are added to 1,000 ml of distilled water.

d-Mannitol (Difco)	10	grams
Bacto tryptone	10	grams
Bacto-agar	15	grams
Sodium chloride, Merck reagent	55	grams
Bacto yeast extract	2.5	grams
K_2HPO_4, anhydrous, Merck reagent	5	grams
Bacto-gelatin	30	grams
Ammonium sulfate, Baker analyzed, A.C.S. pyridine-free	75	grams
Sodium hydroxide, 10%	6	ml

Autoclave for ten minutes at fifteen pounds pressure. Pour while hot, shaking thoroughly to disperse precipitate, each plate to contain approximately 25 ml. The plates must be smooth and free from lumps or air bubbles. The medium is clear while warm but becomes opaque upon cooling. Plates may be stored in sealed petri cans in the refrigerator.

Summary

A recently developed medium specific for the rapid isolation and enhancement of the identifying characteristics of pathogenic Staphylococcus is described.

A routine which will assist in isolating most of the organisms associated with food poisoning is outlined.

REFERENCES

1. Chapman, Geo. H. 1948. An Improved Stone Medium for the Isolation and Testing of Food-Poisoning Staphylococci. Food Research 13 (2): 100-105.

2. Dienst, R. B. 1942. A Study of Recently Isolated Strains of Staphylococcus and Their Ability to Coagulate Plasma. J. Lab. & Clin. Med. 27 (5): 663-665.
3. Felsenfeld, Oscar and Young, Viola Mae 1944. A New Medium for the Differentiation of Salmonella and Paracolon Organisms. Technical Bulletin of the Registry of Medical Technologists 5 (2): 26-27.
4. Dack, G. M. 1943. Food Poisoning. 36-67.
5. Simmons, James S. and Gentzkow, Cleon J. 1944. Laboratory Methods of the United States Army. 5th Edition.
6. American Public Health Association 1945. Diagnostic Procedures and Reagents. 2nd Edition: 219-220.

ABSTRACT

Simple One-Tablet Test for Urinary Chloride in Low Sodium Diets, W. B. Looney, MD., G. D. McGrath, M. D., & W. A. Thomas, M. D. Chicago, Ill., Am. Jr. Lab. & Clin. Med. 38:275-279, Aug. 1951.

This article presents a simple one-tablet urinary chloride test with a brief discussion of its clinical applications.

Urinary chloride determinations are of importance in following salt depletion in human beings. Figures obtained from studying normal medical students, made dehydrated and salt deficient by gastric lavage, showed that moderately severe salt depletion was quickly apparent from the decrease in urine chloride concentration, while it was scarcely detectable from plasma chloride concentrations. During the course of low sodium diets, it is necessary to obtain frequent determinations of electrolytes to avoid excessive imbalance and urinary chlorides are a satisfactory guide to electrolyte change in patients with normal kidney function. Urinary chlorides are also important during the period of additions to low salt diets.

The Fantus Test for urinary chlorides incorporates in one tablet the silver nitrate and potassium chromate heretofore used. The only equipment necessary is a test tube, a dropper calibrated accurately to twenty drops per ml. chloride test tablets,* and distilled water. The test requires 5 drops of urine plus 15 drops of distilled water, allowing two to three minutes for disintegration. The color change is from yellow to reddish brown. If color change takes place with one tablet the sodium chloride is between 0-60 mg. %. If there is no color change with one tablet, two, three, four or five tablets are used until a change in color is produced.

FANTUS TEST
5 drops urine—15 drops distilled water

Tablets†		
1	Less than	60 mg. %
2	" "	60-120 mg.%
3	" "	120-180 mg.%
4	" "	180-240 mg.%
5	" "	240-320 mg.%

* Brunswick Laboratories, Chicago, Ill.
† Number tablets necessary to bring color change from yellow to red to brown.

The authors used 123 specimens to check this method with the standard laboratory method. Most of their experience in using the test was with hypertensive patients on low salt diets. Most work was on routine hospital admissions, out-patients, and one of the men satisfactorily managed hypertensive patients in his office.

The advantages of the test are that most patients with minimum instruction can satisfactorily test specimens at home and report to the doctor over the telephone. Also, they can follow salt balance themselves while on vacation or away from home. The authors believe the test is valid in patients with normal kidney and cardiac damage, but who are com-

pensated. In any borderline cases, they advise more extensive determinations of blood and urine electrolytes. They also found its limited use in handling surgical patients proved satisfactory. The greatest use of the test will be as an intermediate procedure between more extensive electrolytic determinations in patients requiring very close control and as a guide to management of out-patients on low sodium diets.

Esther M. Lemont

AMONG THE NEW BOOKS

APPROVED LABORATORY TECHNIC: 5th Ed. John A. Kolmer, M.D., Dr. P. H. Earle H. Spaulding, Ph.D., and Howard W. Robinson, Ph.D. Appleton-Century-Crofts, Inc., New York, 1951. 1200 pp. 403 Illus. including 28 in color. 78 tables. $12.00.

The general reference book for routine and not-so-routine laboratory procedures comes to us in this long-established volume in its fifth edition. The new section on virology will prove a boon to those who have heretofore found it difficult to locate specific diagnostic methods for practical application. The nomenclature for hematologic studies proposed by the Committee for Clarification of Nomenclature (of blood) is given in the revised chapters on that subject. None of the valuable portions of the older editions are discarded. Instead, many an old familiar technic is retained because it is proven. For the student, the beginner technologist, and for the medical technologist with many years of referring to "Kolmer," this volume will prove its value.

GROUPING, TYPING, AND BANKING OF BLOOD: 1st Ed. Otaker Jaroslav Pollak, M.D., Ph.D., Charles C. Thomas, Publisher, Springfield, Ill., 1951. 184 pp., 27 illustrations, 21 tables, 10 detachable charts. $5.75.

A book written primarily for the blood bank technologist has much of the essential detail for others engaged in this type of work. It is very practical in the definitions of simple blood grouping and typing technics. All blood bank procedures are described in fair detail, with explanations of reasons. Methods for anti-body detection are given together with a brief resume of the effects of iso-agglutinins. This book should be in every hospital blood bank for reference.

COLOR ATLAS OF MORPHOLOGIC HEMATOLOGY: with a Guide to Clinical Interpretation: Geneva A. Daland. Harvard University Press, Cambridge, Mass., 1951. 74 pp., 14 plates, color. 9 diagrams, 12 tables. $5.00.

This newest of the Hematology Atlases is well within the range of the technologist's pocketbook and should be in his laboratory. Of much value to the student, it is more for the hematologist that needs the excellent charts and color plates for constant reference. This little volume will help take care of the gap between the actual blood picture and its interpretation.

AN INTRODUCTION TO UNIVERSAL SEROLOGIC REACTION IN HEALTH AND DISEASE: Reuben L. Kahn, D.Sc., Commonwealth Fund, New York, 1951. 159 pp., 113 serologic charts. $3.50.

On the premise that the serologic reaction with lipid antigen is biologically universal, Dr. Kahn has worked out the various patterns for serologic reactions in disease. Among the diseases to which application has been made are yaws, syphilis, malaria and tuberculosis. Dr. Kahn gives us this book as a preliminary report without attempting to say how far-reaching this work may be eventually.

REVIEW OF PHYSIOLOGICAL CHEMISTRY: 3rd Ed. Harold A. Harper, Ph.D. University Medical Publishers, Palo Alto, California. 1951. 260 pp., 13 illustrations, 13 charts, 23 tables. Paper bound. $3.50.

While this volume is primarily for the physician preparing for his state and specialty Boards, it is valuable for its many tables, definitions, and brief, concise outlines of bio-chemical reactions. The chemistry laboratory can find much of its contents useful as daily reference material.

THE MICROSCOPE: Its Application, Use, and Care: Compiled by E. G. Keller, E. Leitz, Inc., New York. 48 pp. Free copies of this handbook are available to individuals, schools, commercial, and research organizations upon request, on letterhead, to E. Leitz, Inc., 304 Hudson St., New York 13, N. Y.

A pocket-size booklet intended to serve as an introduction to the use and care of the microscope is not designed as a substitute for textbooks or manuals on the subject. Basic facts concerning the use of the microscope, together with up-to-date information on the significant changes in microscope design, explanation of optical and mechanical performance, plus detailed information about objectives, eyepieces, focusing, etc., make it of much value to any microscope user.

ASMT CONVENTION

June 22-26, 1952

Headquarters: The Masonic Temple

1119 S. W. Park St., Portland, Oregon

THE GAVEL

As this issue of the Gavel goes to press, your representatives will be on the way to the Board of Registry meeting in Chicago. Doubtless you may wonder what they do there, but be assured that serious consideration is given by each one to the Board matters. Perhaps some definite matters can be reported in the next issue of this letter. If you have problems during the coming year for the Board meeting in October, 1952, send them to one of the members—past president, president, or president-elect—of ASMT and she will present them to the Board of Registry for the Agenda.

Consider the recommendations your state societies may have for the 1952 meeting of the House of Delegates of ASMT, and begin preparations for amendments to the constitution so that they will be submitted in time for publication in the Journal. Sometimes it is hard to realize that deadlines crop up long before the state committees have completed their plans, so this is but a gentle reminder to help the situation. You are reminded to read your Journal thoroughly and the announcements carefully; and if you must skip any part, the Gavel is probably the one to miss.

The announcements of Fall meetings from state societies are much appreciated, and it is a real pleasure to greet you in anticipation of their success. From these gatherings comes the inspiration for convention papers and program ideas for next year's meeting. Along with the business-like greetings comes the personal desire to wish all of you a lovely holiday and a hearty New Year. By the time you receive this November-December Journal, you will be ready for Christmas activities and the special time of Peace and Good Will.

L. B. W.

PAY YOUR DUES NOW!

ANNOUNCEMENTS
NATIONAL COMMITTEES

MEMBERSHIP

Ida L. Reilly, Chairman, 2517 Rosalind, Roanoke, Virginia: Maine, New Hampshire, Vermont, New York, Massachusetts, Rhode Island, Connecticut, Pennsylvania, New Jersey, Delaware, Maryland, Washington, D. C.

Eleanor Brenny, 302 Brent Bldg., Pensacola, Florida: Arkansas, Louisiana, Mississippi, Tennessee, Kentucky, West Virginia, Virginia, North Carolina, South Carolina, Alabama, Georgia, Florida.

Sister Mary Frieda (Ward), Dominican Novitiate, San Rafael, California: Washington, Oregon, California, Montana, Idaho, Nevada, Wyoming, Nebraska, North Dakota, South Dakota.

Frances Ferne Davis, 1519 West Main, Enid, Oklahoma: New Mexico, Arizona, Oklahoma, Texas, Colorado, Kansas, Utah.

Mrs. Frances Moore Kenworthy, 705 West Elm, Urbana, Illinois: Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, Ohio, Missouri.

Mrs. Lucille Wallace, R. R. No. 2, Cass Lake, Minnesota: Hawaii, Puerto Rico, other territories, A.P.O.'s, and Foreign.

PUBLIC RELATIONS

Frieda Claussen, Chairman, 469 Laurel Avenue, St. Paul, Minnesota
Mary Nix, 4931 N. E. Glisan, Portland, Oregon
Josephine Pyle, Middlesex Hospital, Middletown, Connecticut
Dorothy Patras, 1236 Woodland, Fort Worth, Texas
Ellen Skirmont, 5493 South Cornell, Chicago 15, Illinois
Dorothy Prest, Salem Hospital, Salem, Massachusetts

LEGISLATION

Mr. Wade Marsh, Jr., Chairman, Baronness Erlanger Hospital, Chattanooga 3, Tennessee
Sadie Cartwright, 605 East 51st Street, Savannah, Georgia
Barbara Isbell, 4781 Santa Cruz, San Diego 7, California
Dorothy Lee, 1129 North Bishop, Dallas 8, Texas
Sister Mary Clare (Heath), St. Clare's Hospital, 415 W. 51st St., New York 19, N. Y.
Angela Serafini, 18937 Wisconsin, Detroit 21, Michigan.

STANDARDS AND STUDIES

Sister M. Dolorosa (Pope), Chairman, 1325 South Grand Blvd., St. Louis, Missouri
Lucille Godelfer, 2928 Bell Street, New Orleans, Louisiana
Carolyn Martin, 1201 Clifton Road, N. E., Atlanta, Georgia
Agnes Lyman, 4015 S. E. 30th, Portland 2, Oregon
Sister Mary Leo Rita (Volk), 6420 Clayton Road, St. Louis 17, Missouri
Dorothy McGhee, Rex Hospital, Raleigh, North Carolina

EDUCATION

Rachel Lehman, Chairman, 3939 North Capitol, Indianapolis, Indiana
Mary Frances James, Medical College of Alabama, Birmingham, Alabama
Sister Mary Agnese (Vasco), St. Francis Hospital, 45th St., Pittsburgh, Pennsylvania
Anne Sommer, 1325 South Grand Blvd., St. Louis, Missouri
Rose Hackman, 4200 East Ninth Street, Denver, Colorado
Elizabeth Frey, 678 William Street, Buffalo 6, New York

FINANCE

Loretta Laughlin, 612 Becker Avenue, West, Willmar, Minnesota
Kathryn Dean, 1312 Silverthorne Blvd., Baltimore 12, Maryland
Mary Eichman, 440 Lyceum Avenue, Philadelphia 28, Pennsylvania
Louise Vance, 105 South York, Elmhurst, Illinois
Howard Moss, 28 Philip Street, Haverhill, Massachusetts
Mrs. Virginia Wier, 525 Jackson, Denver, Colorado

RESEARCH

Mrs. Hazel Suessenguth, Chairman, 1838 E. 101 St., Suite 214, Cleveland 6, Ohio
Margaret Hughes, 930 S. W. Whitaker St., Portland 1, Oregon
Elvyn Scott, Lorelei Road, Route 4, Wilmington, Delaware
Betty J. Tatting, 310 Eleventh Ave., Salt Lake City, Utah
C. Hartzell Payne, Route 1, Terre Haute, Indiana
Mrs. Mary B. Clark, 301 McCready, Louisville 6, Kentucky

SPECIAL COMMITTEE, Civil Service-Armed Services (ASMT-ASCP)

Mrs. Lucille Wallace, Chairman, R. R. No. 1, Cass Lake, Minnesota
Mary Eichman, 440 Lyceum Ave., Philadelphia 28, Pennsylvania
Lavina White, Pueblo Clinic, Pueblo, Colorado (ex-officio)
Dr. Frank B. Queen, Dept. of Pathology, University of Oregon, School of Medicine, Portland, Oregon (ASCP Representative)

p311 removed.
On backside of title page

NOMINATIONS AND ELECTIONS

The Nominations and Elections Committee wishes to call attention to the list of officers to be elected at the next annual meeting of the House of Delegates of the American Society of Medical Technologists. The committee has published announcements in the NEWSLETTER and the JOURNAL requesting all officers, affiliated societies of A.S.M.T. and individual members of the society to send to the committee their selection of candidates for the offices vacant. It is important that we have the names and qualifications of the proposed candidates from those who best know their qualifications. They must be members of A.S.M.T. in good standing and must have been members for at least two years. NOW is the time to voice your opinions as to whom you would like to have nominated to these positions.

All suggestions must be in the hands of the committee members by December 1, 1951.

The offices to be filled and those now holding these offices are as follows:
President-elect: Sadie Cartwright.
Recording Secretary (one-year term): Sister Charles Miriam (Strassel).
Board of Directors (three-year term): Anne J. Sommer and Grace Ballard.
Please send your communications at once to:
Violetta A. Wakefield, Chairman, 1209 N. 34th St. Ft. Smith, Ark.
Louise Miller, 2102 Kecoughtan Rd., Apt. 21-D, Hampton, Va.
Lucile Harris, Hendrick Memorial Hospital, Abilene, Tex.
Eleanor Fulton, 537 Millard St., Saginaw, Mich.
Arlene Parks, 434 Grand Ave., Apt. 44, Dayton, Ohio.
Marguerite Pitinga, 211 4th St., Colorado Springs, Colo.

CONSTITUTION AND BY-LAWS

The Constitution and By-Laws Committee wishes to remind the membership that all proposed amendments to the Constitution or By-Laws must be submitted to this committee. The material must reach this committee by January 1, 1952, in order to give the committee sufficient time to study carefully and reword, if necessary, to conform with the Constitution and By-Laws and to be published in the March issue of the Journal.

We would like to request that the proposed amendment be accompanied by a discussion of the reasons for the proposal. The committee will attempt to compile and present to the membership a summary of the discussion. We would also like to suggest that each state study the proposed amendments and instruct their delegates as to their wishes on the matter. This would eliminate excessive debate in the House of Delegates.

Constitutions or amendments to be approved by this committee should be sent to the chairman of this committee. Please send six copies.

The members of the Constitution and By-Laws Committee are:
Margaret Haraway, Chairman, 427 Osler Bldg., Oklahoma City, Okla.
Ada Sidor, Box 1106, El Dorado, Kan.
John A. Mooty, 118 W. Third St., Beaver Dam, Wisc.
Mary Yeaton, 34 Castle St., Worcester, Mass.
Charlotte Thumm, 3323 Denison Ave., Cleveland Ohio.
M. Claire Murray, Box 476, Jamestown, N. D.

PAY 1951-52 DUES NOW!

This is your last copy of THE JOURNAL until 1951-52 dues are paid. Reinstatement fee of $1.00 is required if dues are not mailed before January 15, 1952.